Of this issue more than 4000 copies were printed

The Welding Engineer

Vol. 1 | Chicago 608 S. Dearborn St. | MAY, 1916 | $2.00 per year in U. S. $2.50 per year abroad | No. 5

This Welding Process Has a Place In Every Shop and Factory

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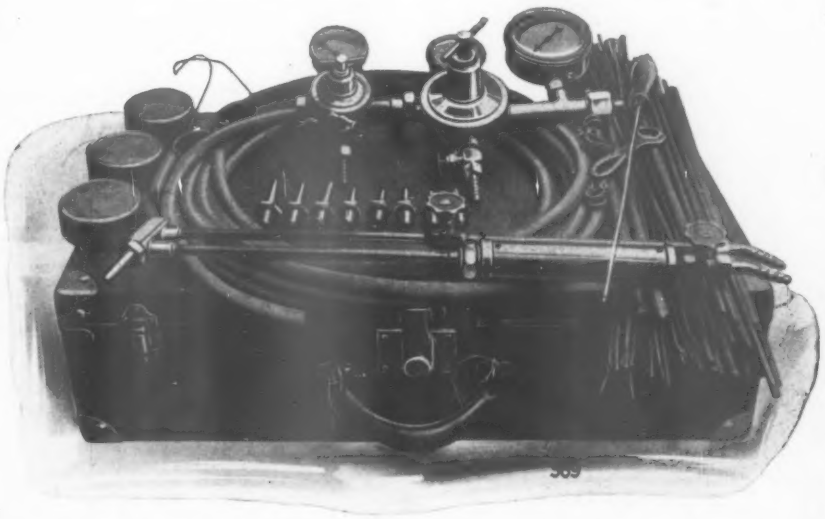

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Every Welder should have our new catalog No. 132, just off the press. Gives operating costs, views of work actually done and other valuable data.

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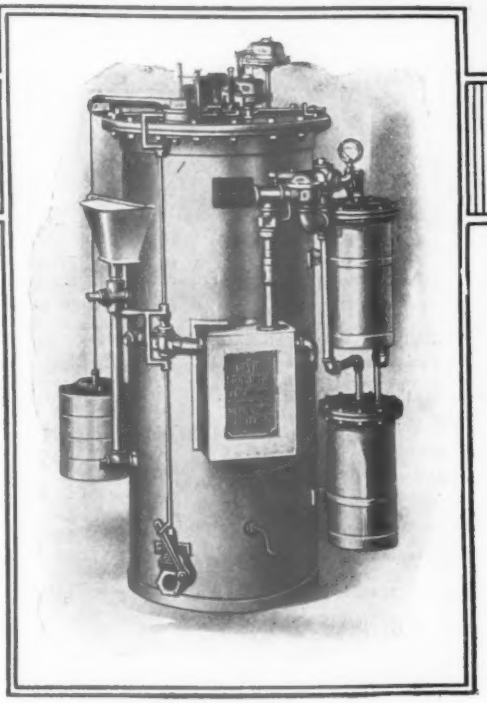
The remarkable success of oxy-acetylene welding with its value to metal working trades, was made with acetylene generated on the premises.



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Those concerns making the greatest use of the process and who have established the greatest confidence in its efficiency, use acetylene generators—generating the gas on their own premises as wanted, piping it directly to welding or cutting stations. Many such concerns have two, three or four Davis generators of the largest size, connected in series, some running night and day. Hundreds of general repair shops are equipped with small generators for their shop work and portable tanks for their field work, thereby obtaining full measure of efficiency and economy. Acetylene can be safely generated on the premises with an approved generator at a cost much less than for compressed acetylene in portable tanks—it can be produced as it is required, under suitable conditions for the highest grade welding or cutting, and avoiding the chance of running out of gas when it is most wanted.

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	CARBIDE CAPACITY			GAS PER HOUR	No. of Hours*	TOTAL GAS
	Portable	Standard	Navy-Type	Cu. Ft.*		Cu. Ft.*
No. 25	25 lb.	25 lb.	.....	25	4½	112½
No. 50	50 lb.	50 lb.	.....	50	4½	225
No. 100	.....	100 lb.	100 lb.	100	4½	450
No. 200	.....	200 lb.	200 lb.	200	4½	900
No. 300	.....	300 lb.	300 lb.	300	4½	1350

*The rules and regulations of the National Board of Fire Underwriters provides that an acetylene generator shall be of sufficient capacity to supply gas to all torches in use from one full charge of carbide for a full working period of one-half day, or four to five hours, with a normal output of 1 cu. ft. of gas per hour per pound of carbide. In determining charges, lump carbide to be estimated as capable of producing 4½ cu. ft. of gas to the pound.

The Davis generator was the first one designed and provided with independent power for automatically feeding carbide to water to supply acetylene under pressure up to 15 pounds for use with the oxy-acetylene process. It was the first pressure generator inspected by the Underwriters' Laboratories and listed by the National Board of Fire Underwriters. Its reputation has been established by many years of most successful operation and *there are more Davis generators in use for oxy-acetylene welding and cutting than of any other make.*

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Henderson-Willis Welding & Cutting Co.
The Imperial Brass Mfg. Co.
Vulcan Process Co.
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The Macleod Co.
Oxweld Acetylene Co.
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The Thermalene Co
United States Welding Co.
Universal Oxygen Co.

WELDING TORCHES (Oxy-Hydrogen)
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Bermo Welding Apparatus Co.
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Oxweld Acetylene Co.
Superior Oxy-Acetylene Machine Co.
United States Welding Co.
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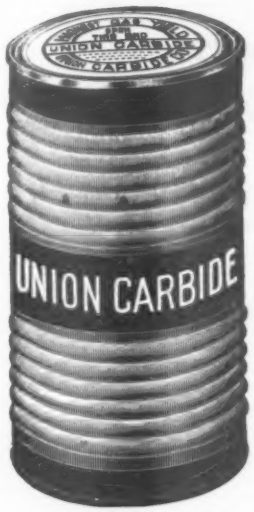

Packed in Blue and Gray Drums

Union Carbide Sales Company

New York City, 42nd St. Building | **Chicago, Ill., Peoples Gas Building** | **San Francisco, Cal., Kohl Building**

SOLE DISTRIBUTORS OF

UNION CARBIDE

"World's Best Quality—Highest Gas Yield"

For Oxy-Acetylene Welding Plants

Contractors' Flare Lights, Torches and Private and Municipal Lighting Plants

"Union Carbide" is packed in 100-lb. blue and gray drums marked conspicuously, "UNION CARBIDE."

The following sizes are carried in stock in 100-lb. drums:

$3\frac{1}{2}$ x 2 in. —a large size.

$1\frac{1}{4}$ x $\frac{3}{8}$ in. —an intermediate size.

2 x $\frac{1}{2}$ in. —a medium size.

$\frac{1}{4}$ x 1/12 in. —finely crushed size.

Union Carbide in the Generator sizes above listed will be shipped direct to consumers from a **Union Carbide Sales Co.** warehouse at any one of the following points where large stocks are kept on hand:

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Phoenix—16 S. Central Ave.
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Eureka—109 Second St.
Fresno—932 H St.
Los Angeles—639 Gibbon St.
Sacramento—1523-31 Front St.
San Diego—326-336 Fifth St.
San Francisco—Kohl Building.
COLORADO
Denver—Nineteenth and Wazee Sts.
Victor—Third and Diamond Sts.
CONNECTICUT
Hartford—877 Main St.
DISTRICT OF COLUMBIA
Washington—Maryland Ave. and 9th St., S. W.
FLORIDA
Jacksonville—106 E. Forsyth St.
Tampa—418 Tampa St.
GEORGIA
Atlanta—Cor. Haynes and Rhodes Sts., P. O. Box 1594.
Savannah—Ogeechee Canal, South of Bay St., P. O. Box 78.
ILLINOIS
Chicago—Peoples Gas Bldg., Michigan Blvd.
Decatur—133-147 W. Williams St.
East St. Louis—600 Walnut Ave.
Marion—315 S. Granite St., Box 747.
Monmouth—601 S. First St.
Quincy—222 S. Eighth St.
Streator—702 East Elm St.
INDIANA
Evansville—1601 Illinois St.
Indianapolis—110-112 S. Alabama St.
Terre Haute—921 Wabash Ave.
IOWA
Des Moines—117-119 Fifth St.
Dubuque—8th and Washington Sts.
Ottumwa—207-9-11 S. Washington St.
Sioux City—925 Fourth St., P. O. Box 398.
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Pittsburg—109 W. Third St.
Salina—103 S. Fifth St.
Wichita—721 Beacon Building.
KENTUCKY
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New Orleans—715-717 Perdido St.
MAINE
Portland—202 Commercial St.
MARYLAND
Baltimore—19 E. Lombard St.
Cumberland—1 N. Liberty St.
Salisbury—Opp. Fulton Station.
MASSACHUSETTS
Boston—(See Cambridge "A.")
Cambridge "A"—Waverly St. and Putnam Ave.
Springfield—Napier St.
MICHIGAN
Detroit—Jefferson Ave. and Orleans St.
Grand Rapids—135 Ottawa Ave., N. Y.
Hancock—First National Bank Bldg.
Iron Mountain—215 E. A St.
Jackson—172 South Water St.
Saginaw—1902 N. Michigan Ave.
Sault Ste. Marie.
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Minneapolis—334 N. First St.
Virginia—413 Chestnut St.
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Vicksburg—1312 Washington St.
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Kansas City—1316-1318 W. Eighth St.
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Omaha—1007-9-11 Jones St., Union Sta. P. O.
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Concord—77 South Main St.
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Camden—Delaware Ave. and Cooper St.
Jersey City—554-56 Henderson St.
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WASHINGTON
Seattle—411 Globe Bldg., First Ave. and Madison St.
Spokane—646 Peyton Building.
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Madison—309 East Wilson St.
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We recommend our customers to **select** from the list, the **city** from which the quickest delivery and lowest **freight rate** can be obtained, **and address their orders to "Union Carbide Sales Company"** at the distributing point selected **accompanied by remittance.**

Please address request for information or special correspondence to either the Chicago or New York office.

The
BASTIAN-BLESSING COMPANY
125-131 W. Austin Ave.,
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Specialists in Dependable Regulators

We also manufacture apparatus parts, torches, etc., on contract, per sample. Let us figure on your next order.

REGO TRADE MARK

We Sell Manufacturers and Jobbers Only

Welding and Cutting Outfits

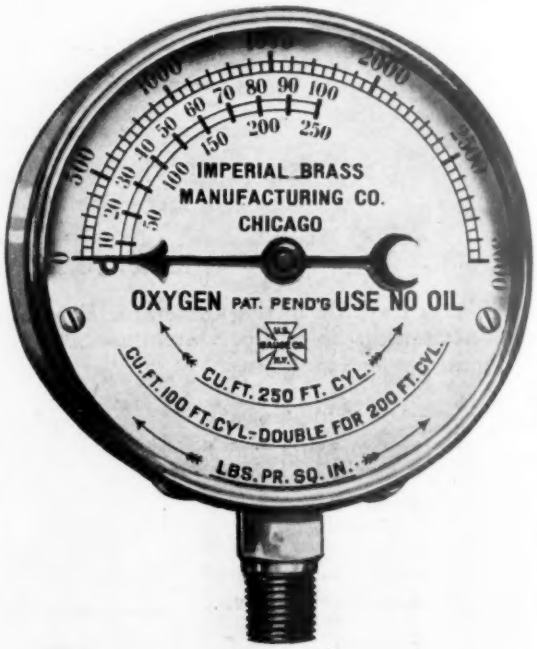
American outfits are made to make good. They are carefully designed and made from the very best materials, with but one object in view—to secure the very highest commercial efficiency.

American torches are constructed for constant heavy service and are free from back-firing and danger to the operator. The needle valves are conveniently located, which permits the operator to adjust flame with torch hand and without laying aside welding stick.

Write for our descriptive circular. It's full of good information.

American Welding Co., Inc.
2724 Michigan Ave. Chicago, Ill.

U. S. Gauge Company
New York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OXYGEN PAT. PEND'G USE NO OIL
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CU. FT. 100 FT. CYL.-DOUBLE FOR 200 FT. CYL.
LBS. PR. SQ. IN.

The IMPERIAL BRASS MFG. COMPANY has adopted the U. S. GAUGE as standard on their equipment. Its record in service, together with distinctive patented safety features commend it to the best trade.

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For Gas Cutting or Welding
For Electric Welding Apparatus
For Arc Welding Apparatus

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Ventilated Sides
Heavy Elastic
Leather Nosepiece

Ask your jobber for either of these. He can supply you.

Lenses of any color or shade desired.

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Fibre Frame an Absolute Non-Conductor of Heat

Manufactured by **CHICAGO EYE-SHIELD CO., 2300-06 Warren Ave., CHICAGO, ILL.**

GAS THERMALENE — THE GAS OF GREATEST EFFICIENCY — GAS THERMALENE

The Oxy-Thermalene Method
of Welding, Cutting, Brazing, Etc.

The only Acetylene Oil Gas generator in the world. Saves 25% on gas and oxygen. First class references. We also sell complete Oxy-Acetylene equipment for dissolved Acetylene for $42.00.

Thermalene gas in conjunction with Oxygen gas produces the ideal flame for welding and cutting. There is no loss of time due to shortage of gas. The generator works only when you work. When shut off, generator ceases instantly.

Thermaline will not produce faulty welds due to impure and moist gas. The generator may be mounted on a truck and made portable.

Thermaline Gas, being heavier and richer than Acetylene and other gases, has more body, producing a softer non-oxidizing flame, which assures a more uniform weld and a cleaner cut, without burning or making the metal brittle.

Write for full information, catalog and prices.

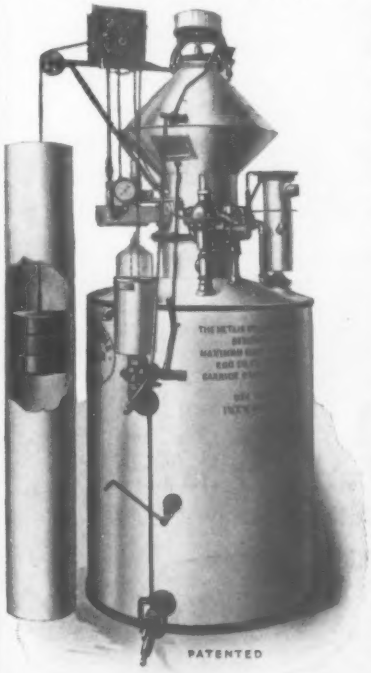
THE THERMALENE COMPANY
Chicago Heights, Ill.

GAS THERMALENE — THE GAS OF GREATEST EFFICIENCY — GAS THERMALENE

This Generator is Foolproof

For safety, strength, durability, workmanship and simplicity of operation, the "Metal Welding," new type, positive feed, pressure acetylene generator, excels any other generator on the market. The "Metal Welding" generator is made of heavy sheet steel, **every seam and every fitting is welded** (not soldered and riveted), it is galvanized after welding, thus guarding against any possible corrosion. There are no joints or seams to leak as is the case where rivets and solder are used. It is practically a one-piece generator.

The blow-off valve is set to operate at 15 pounds pressure, and is large enough to instantly take care of any amount of gas generated, always closing when the pressure is reduced to 15 pounds. The seat of the blow-off is kept in perfect condition at all times by being opened and closed each night, also each time the generator is recharged. This feature is original with this generator blow-off and eliminates all possibility of seats being frozen from lack of operation. These generators are equipped with flashback preventers and are **absolutely foolproof,** being equipped with interferences which makes it impossible for any part of the machine to be opened while there is gas in the generator.



Made in two sizes, Model B of 100 pounds and Model C of 200 pounds carbide capacity. The construction of these generators exceeds the rules and regulations of the National Board of Fire Underwriters.

Write for catalog.

The Metal Welding Co.
Cleveland, U. S. A.

REMOVAL NOTICE

To provide adequate quarters The Welding Engineer has removed to the Transportation Bldg., Harrison and Dearborn Sts., 608 S. Dearborn St. The telephone number remains the same.

WANTED—BACK ISSUES

The Welding Engineer is in receipt of many requests for the January, February and March numbers. Unfortunately our reserve supply is entirely exhausted. For the return of every copy of either of the above issues we will be glad to extend subscriptions three months for every copy returned. Our honest advice, however, is to buy a binder and keep your file intact.

L. B. MACKENZIE,
608 S. Dearborn St., Chicago.

Better Welding

Results are certain when your acetylene is made from pure Carbide, because the heat is more intense when the acetylene is free from impurities.

Carbolite

is a very superior quality of Calcium Carbide—Made from the best raw materials obtainable—in fact it is the best Carbide that can be produced and has the highest averaged gas yield.

Packed in drums containing 100 lbs. net.

Warehouses in principal cities.

Write for Quotations and further Information

American Carbolite Sales Co.
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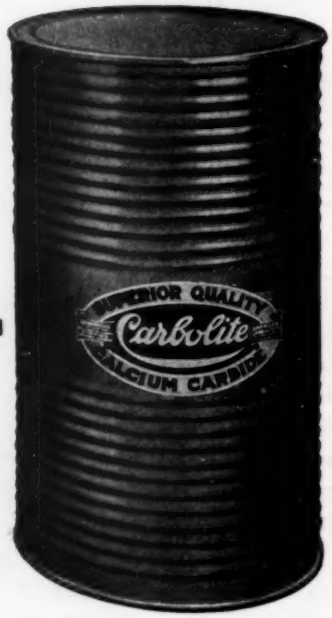

Welders Goggle No. 5

The above cut represents our No. 5 Goggle, Leather body with collapsible cups. Mounted with Dark Gray Green glass, Light for Cutting, Medium dark for Welding and Extra Dark for heavy work, also furnished with Blue, Amber or Clear White glass.

Per pair.....$1.25
Prices in quantity upon application.

This is one of our best selling goggles. It is light and comfortable to wear and being made of leather there is no metal parts to get heated and burn the skin.

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Manufacturer, Importer and Wholesale Dealer in
WELDING GOGGLES AND PROTECTION GLASSES

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Write for Catalog. Samples Submitted

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A large stock of torches, regulators, gauges, reducing-valves, copper wire bound high pressure hose and plain black rubber gas hose, and all extra accessories and supplies for this line of work, is in our shops, New York City, at your demand.

The K-G Apparatus is accepted by those who know as the best money can buy. It is built to stand up.

This is not merely a statement of our opinion, but is proven by their universal adoption and long continued use.

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Universal

UNIVERSAL OXYGEN COMPANY
SHEBOYGAN, WISCONSIN, U.S.A.

PURE OXYGEN and HYDROGEN GASES
WELDING and CUTTING EQUIPMENT
Milwaukee Branch: 315 Fourth Street

You Are Paying for an
I.O.C. SYSTEM OXYGEN and HYDROGEN
GENERATING PLANT

I.O.C. Unit or Cell Type Generator

If you are buying gas in cylinders, you are spending enough money to pay for an I. O. C. Plant of your own—but you're not owning the plant. An I. O. C. Plant will give you gas at about 1-3 the cost of cylinder gas—the 2-3 you save will quickly pay for a generating equipment that you will ultimately own and can operate at maximum profit. Let us go into this point with you, thoroughly.

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Send for it.

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Welding Plants
for All Purposes

12 Sizes—Ranging in price from
$25.00 to $250.00

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A 'BERMO" Plant means more profit for you.

Shipment made same day order received.
Liberal terms on plants if desired.

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Bermo Welding Apparatus Co.
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How To Turn Experience Into Money

We are learning something every day about the art of welding. Old methods are being discarded and new methods employed. The Welding Engineer is anxious to hear from men with ideas—in fact, we pay for ideas. Put your experiences on paper—make rough pencil sketches of your ideas. We will put your ideas in readable form and pay you well.

Write Me Today

THE WELDING ENGINEER, L. B. Mackenzie, Editor
608 South Dearborn Street, CHICAGO

WILLIS OXY-ACETYLENE APPARATUS WELDERS

"WILLIS" PRESSURE GENERATORS

"Willis" Pressure Generators are made in sizes of 50 pounds, 100 pounds, 200 pounds and 300 pounds capacity of carbide per charge.

The generator of 50 pounds capacity is standard for repair shops and light manufacturers, while the larger sizes provide an ample supply of gas for more extensive use.

The "Willis" Pressure Generators stand alone. The theoretical engineer and the practical welder proclaim their superiority. One of the important features to be considered in an acetylene generator is

Safety. We have made **safety** the first consideration, and how well we have succeeded is attested by the fact that we have never had an accident or explosion occur to any of our apparatus—a record held only by this Company. Our apparatus is as near "fool-proof" as it is possible for mechanical appliances to be.

The "Willis" Generators have independent power for feeding lump carbide and automatically starts and stops according to the pressure of the gas. These generators require no attention after being filled with carbide.

THE WELDING TORCH

Of equal importance to the Acetylene Generator is the welding torch itself. The "Willis" torch knows no equal. It is of the medium pressure type, and is known as the Constant Neutral Torch. The mixture of the gases is obtained in the head, and interchangeable tips of different capacity are provided to regulate the size of the flame.

Heads having different angles are furnished and are also interchangeable. This is a special patented feature of our torch and is found to be of great assistance to the operator. For ordinary bench work a torch having a head at about a 90 degree angle is most desired, while for boiler welding such as side, flue, or crown sheet work, a much greater angle than 90 degrees is preferable. These heads of different angles all fit the same torch. Another advantage which the "Willis" torches possess is that the heads rotate on the torch proper and are easily and quickly turned to any angle in the arc. For overhead work and certain other classes, this is of great assistance. These features give the torch pre-eminence as to facility. We guarantee our torch to procure as low a ratio of oxygen to acetylene as it is possible to obtain and maintain a neutral flame.

THE CUTTING TORCH

The Welding Torch can be easily and quickly transformed into a Cutting Torch by simply removing the Welding head and replacing same with the cutting attachment. This attachment connects with the oxygen supply for welding and only one oxygen hose is required. With this cutting torch it is possible to cut in any direction, as the oxygen jet always impinges on hot metal.

MANUFACTURED BY

The Henderson-Willis Welding and Cutting Co.

GENERAL OFFICE AND FACTORY

ST. LOUIS, MO., U. S. A.

Swift Oxygen

For Welding and Cutting

Unsurpassed for Quality

Pure Oxygen Electrolytically Made under the direct supervision of our Chemical Laboratory. It is carefully controlled by chemical analysis, thus insuring the highest obtainable purity.

We carry a large stock on hand so can fill orders immediately.

Swift & Company

Oxygen Department **Union Stock Yards, Chicago, Ill.**

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Sales Agents of

CANADIAN CARBIDE

"More gas per pound"

SIZE PKGS.
100 lb. and 1,000 lb. 25-lb. drums; 10 lb., 5 lb., 2 lb., 1 lb. tins

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Manuf'd in all standard sizes

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Regulators

you can depend upon. Guaranteed to be absolutely accurate and to remain so.

The Patented Features of this regulator means that adjustment or replacement of the valve seat can be made by anyone using only a wrench and screw driver.

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Complete welding equipment

F. C. KUHNLE & CO.

Manufacturers of
THE GRANT REGULATOR
(Patented 1915)
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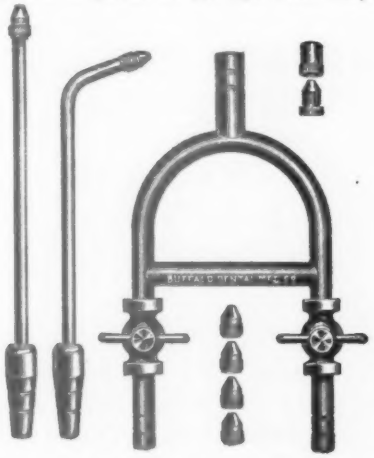
FOR LEAD BURNING

Our No. 28 Oxy-Hydrogen Lead Burner is most complete. Equipped with taps that are ground to a seat, making them easy to manipulate—safety gauzes in the throat of the yoke to prevent accident by a flashing back of flame—a series of jet tips with varying sized



orifices, and a wind shield adjustment to permit its use in draughty places. A straight and curved burner shaft that will meet every possible condition. Price, complete with 5 feet rubber connecting tubing, $7.00. Ask for catalog "B. X.," illustrating and describing this and all our chemical laboratory apparatus.

Buffalo Dental Mfg. Company

Buffalo, N. Y., U. S. A.

UNITED STATES WELDING COMPANY

FORMERLY CAMPBELL & RICKEL

MINNEAPOLIS, MINN.

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OXY-ACETYLENE
WELDING
CUTTING

CARBON BURNING
APPARATUS

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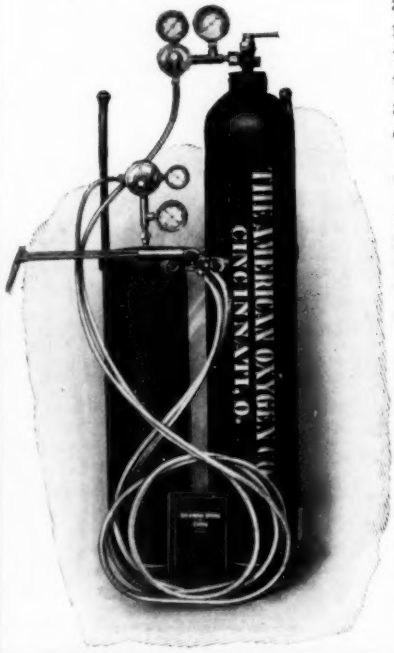
Pure Oxygen

Pure oxygen is essential to good work. If your oxygen supply is not up to the standard set by "American" and "Watergas" oxygen then the best welding and cutting apparatus to be had will not do your work properly.

We are glad to recommend "Vulcan" welding and cutting apparatus to our customers. No better tools are made and when used in connection with "American" and "Watergas" oxygen, with high grade acetylene, we know our customer will get results.



Write our nearest office for prices. Prompt shipments made at all times.

American Oxygen Co.
Cincinnati

Indiana Oxygen Co.
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HOOVER WELDING AND CUTTING APPARATUS

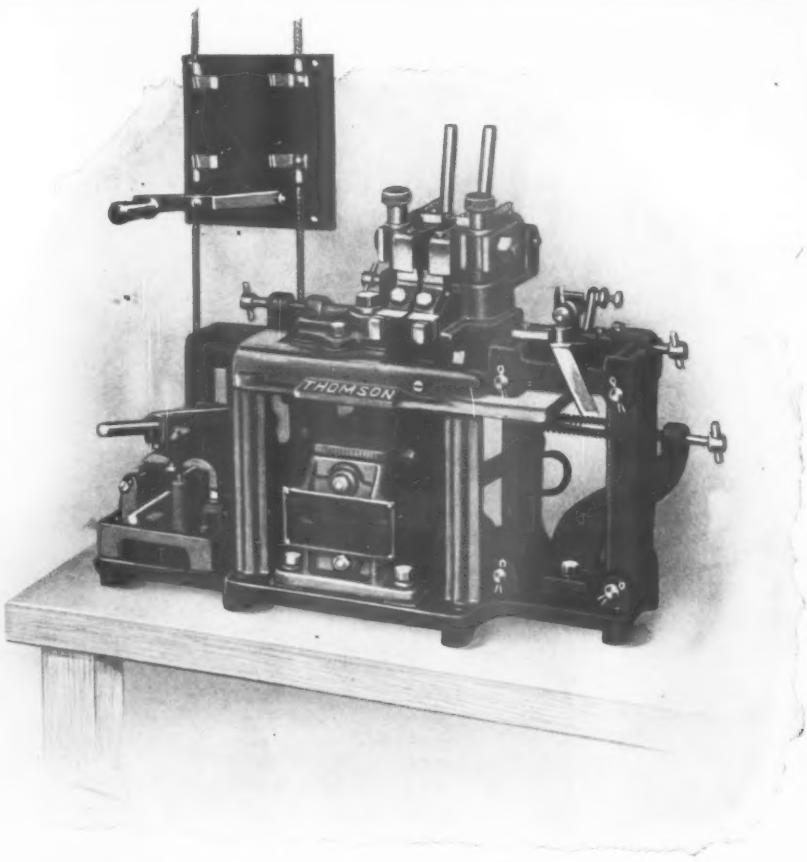
This new welding and cutting torch represents the very last word in efficiency. The Hoover torch can be adjusted to any class of work, large or small. With it the operator may meet and overcome difficulties usually requiring at least five different torches.

REASONS WHY

1. The Hoover torch is adjustable to every job.
2. It is possible to manipulate the valves with the **torch hand**, leaving the other hand free. This is a big advantage.
3. "Flash Backs" are reduced to the minimum in the Hoover torch. The mixing chamber is remote from the heat.
5. The cutting head has no tips, being cast en bloc. There are no joints to work loose and leak.
6. The Hoover torch is well balanced and is light.
7. The materials and workmanship employed in manufacture are of the very best.

Before you buy you owe it to yourself to get our prices and circular. Shipment on the day you order.

OXY-ACETYLENE PRODUCTS CO.
810 Diversey Parkway, CHICAGO



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A Modern Way, Yet Not New. Quickest — Cheapest — Best. No Smoke, Heat, Dirt or Glare. Easy — Swift — Sure. No Expensive or Expert Workman— Always Ready. Current Cost Small.

Type 1-A Electric Welder

Capacity up to No. 10 Wire

Steel, brass, platinum and special steels together or in combination. 1500 watts 1 second. Less than 1 KW. hour 1000 welds. 14x24x16 inches high. 120 pounds.

Describe the shape, tell us the size of the smallest and largest piece, the maximum number of welds required per day, the cost of current per kw. hour; we will then tell you what it will cost you to electric-weld. If you haven't an alternating current, your local Lighting and Power Company has.

Weld Your High-Speed Steels
We Job Weld Also

Thomson Electric Welding Co.
Lynn, Mass.
The Pioneer Manufacturers

Oxweld Apparatus For Railroad Service

is to broken equipment what a new point is to your pencil. Its use gets the other 95% value out of your equipment that has broken long before its mechanical life should have gone.

Reclaim the profits discarded in your scrap pile with our Oxweld outfit. A broken tooth on a gear is easily built up and refinished and the gear goes back to work for its full life, and so on throughout the whole list.

On your wrecking trains this outfit will prove of untold value. Tangled steel wreckage is quickly cut up; service is quickly resumed. The cost is tremendously reduced. The profit is the difference between scrap value and replacement cost, less the small cost of repairs.

Oxweld Railroad Service Company

Railway Exchange Building
Chicago

30 Church Street
New York

Abnormal business conditions
What we are doing to meet them Chapter A.

LINDE—IZED
AIR-PRODUCTS

Reducing prices in the face of heavy orders

Since April, 1915—

in the face of an increased demand for our product which taxed our manufacturing capacity to the limit, we voluntarily **reduced the price of LINDE OXYGEN approximately 15%.**

During the Same Period:

Pig Iron	has **advanced** in price approximately	28%
Billets	" " " " "	51%
Steel Scrap	" " " " "	72%
Coke	" " " " "	75%
Copper	" " " " "	80%

Linde Oxygen

is, therefore, practically the only commodity used extensively in the steel industry, which costs the consumer less today than it did 12 months ago. We could easily have taken advantage of abnormal business conditions to raise our prices. A higher price would have been justified on the score that Material and equipment for new plants had advanced 30 per cent.

We deemed it better business to adhere to our early announced policy—namely, to reduce the price as our increased manufacturing facilities cheapened the cost of production.

We believe that this policy has been the biggest single factor in the tremendously increased demand for our product—An increase which has made necessary the building of ten new Linde factories and an investment exceeding two million dollars in new cylinders—since April 1st, 1915.

Interesting new details concerning our ten new plants and new-cylinder-contracts will appear in this space in statements to follow.

The Linde Air Products Company
42nd St. Building, New York City, N. Y.
"Largest Producers of Oxygen in the World"

The Welding Engineer

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The Welding Engineer has made application for membership in the Audit Bureau of Circulations.

We guarantee that of this issue more than 4,000 copies were printed, excluding copies spoiled in press room and bindery. At the time of mailing the known distribution was (actual count always exceeds press order):

Copies to paid subscribers	1,650
Copies to advertisers	46
Copies to prospective advertisers	140
Copies to other trade papers, correspondents, etc.	16
Copies mailed as samples to prospective subscribers	1,838
Copies retained at office of publication to fill new supscription orders, etc.	300
Copies for office use	10
TOTAL	4,000

VOLUME I. MAY, 1916. NUMBER 5

The Prodigal Manufacturer.

IT is a fact that American manufacturers are prodigal. It is only when we are confronted by stern necessity, backed into a corner, in fact, that we burnish up the "ways and means" committee and seek relief in improved and more economical manufacturing methods. The truth of this is well illustrated by the high-speed steel situation. A few months ago machine shops gave little heed to the question of economy. The situation has changed, however, and high-speed steel is not only expensive, but hard to obtain. So immediately we do something. We find that by welding a small portion of high speed steel to ordinary tool steel we perpetuate the visible supply.

As time goes on we shall find that there are still further unheard of applications of weldings systems, by which manufacturing and maintenance expenses may be reduced.

The Welding Organization.

IN the April issue we published a letter from a reader, Mr. Leo A. Baron, in which a national welding association is advocated. We hope readers of *The Welding Engineer* will consider what Mr. Baron has to say carefully. That a national organization of welding interests would serve a useful purpose, if properly organized and managed, there can be no doubt. Any trade is always benefited by an exchange of opinions and ideas and if there is a man living today who is engaged in the welding business and who has nothing to learn about welding we do not know him.

Mr. Baron also speaks of what a national organization would be able to accomplish by hampering the sale of unsafe apparatus. This is a problem manufacturers of welding equipment must face and solve sooner or later. It is useless to close our eyes to the fact that unsafe apparatus is being marketed. This is a hardship for reliable manufacturers and is retarding the progress of the whole field as well. We believe there is not a reliable manufacturer of equipment in the United States who would not be willing to meet any reasonable specifications which would contribute to the safety of operators.

If a national welding association should be organized it should be formed with care and thought. A false start would be fatal. No particular branch of the trade should predominate and no particular interests should be served. The association should represent welding interests of every character.

The Welding Engineer is frank to confess that a national organization looks good to the Editor. We don't want to be the official organ—in fact we would decline the honor if necessary—but we do know that the general prosperity of the welding industry is of great importance to us and we are willing and anxious to do everything possible for the cause.

We would be glad to hear from the trade on this subject.

Letters to the Editor.

WE are glad to say that we have received a great many letters complimenting us on the beginning *The Welding Engineer* has made. We don't print them because we entertain the belief that our readers pay for something besides laudatory conversation about ourselves. We are glad to have letters from our friends, however. They are not only gratifying, but serve to spur us on to greater efforts.

Very few of us go through life, however, without hearing some uncomplimentary things about ourselves. For instance, we have a communication from a reader in Minnesota, in which he says: "You may stop sending *The Welding Engineer*. I can't find anything in it what I did not know long ago." And so it goes. Somebody is always taking the joy out of life. Our reader can't find one solitary little piece of information in *The Welding Engineer* "what he did not know before." We have one little ray of comfort, though, and when we think of the outraged feelings of some of our authors we are forced to laugh.

Japan Becomes a Creditor Nation

THE fact that Russia has been negotiating in Japan for a loan of $25,000,000 emphasizes the importance of recognizing Japan's gains through the fortuitous circumstance of a great war. Japan's foreign trade is rapidly expanding. She is getting into a first-rate financial position. Her internal and external debt is being steadily reduced. It was said in London a month ago that by April 1 her floating treasury notes would all have disappeared. A consistent policy of turning external into internal funded indebtedness is being carried out. A loan to a European power is an outstanding advertisement of the Japan of the future.

The activity of Japan in various markets all over the world has come in for comment in many places. Official French investigators have remarked the growing excellence of quality in Japanese manufactures. The visit of the Japanese commercial embassy to Australia, New Zealand, Chile and other countries in the Pacific was followed by the establishment of direct lines of ships to these countries and of official exhibits of Japanese goods at many points.

It is said on good authority that there are more than 60,000 trained Japanese soldiers living in the Western part of the United States. If Japan has any intention of ever attacking the United States no doubt these Japanese ex-soldiers are armed and organized. In the light of what our troops have been unable to do to Villa, who has a few hundred half-starved, undisciplined soldiers with him, we wonder what 60,000 Japs would do.

Aluminum Welding

Chapter 3. Previous Articles of this Series Were Published in Issues of March and April. The Experiences of a Successful Welder

By Harry B. Hoover

Aluminum should never be welded only from one side with the exception of a few instances, such as a small lug magneto stand or something of that nature, where the expansion and contraction would take care of itself and not put any strain on the body of the case.

In welding aluminum from one side the operator should have a helper. The case should be put in a position where both sides of it could be got at at the same time, the operator working from the outside and welding all the way through while the helper would work the inside of the case using a paddle (same as the operator) and when the metal was brought to a molten condition on the inside the two edges of the fracture would be puddled together by the helper and smoothed off and kept that way until the weld was finished on the outside, in this way the metal is welded all the way through and finished up at the same time. This saves time, makes a strong weld, neat job and prevents warping and check cracking.

When the weld is made half way through from one side

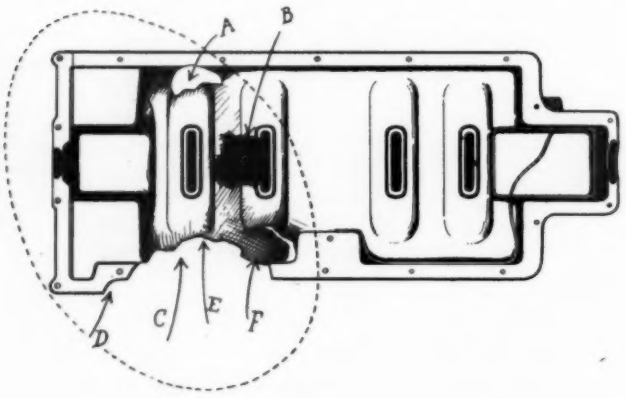


Fig. 1.

then turn over and finish from the other (the same as in ordinary cast iron work); it is almost impossible to make a perfect job of it, as this chases the contraction and expansion back and forth through the casting causing it to check crack and in a great many cases shrinking the metal to such an extent that the case is warped out of alignment.

If the job is a large one and requires a long time to weld it the second helper is sometimes necessary to handle the preheating torch; in this way the operation can be carried straight through without the loss of time, of stopping to preheat occasionally as mentioned here-to-fore.

Case shown in Fig. 1 is a rather difficult job as it has a false or double bottom, this makes it hard for it is necessary to keep the two bottoms expanded evenly and allowed to contract evenly the parts broken out are all missing.

To fill in the missing parts, the better way is to form a piece of sheet iron to fit the case on the outside covering the broken out place, making it fit snug, the outer edge should be flanged the same as the case, clamp this in position thus making a mold, make a mixture of plaster paris and ground asbestos just about as thick as mortar and pour it into the mold, fill the mold a little more than even with the case so that when it dries it will still be thicker than the case. After it is dry take it out and use it for a pattern, have a casting made at the aluminum foundry. If there is no foundry in vicinity take a ladle of melting aluminum and pour the mold full or as near so as possible and allow to cool and then when welding the deficiencies can be filled in from the filler rod. The former is far more the most practical, except in small openings then the latter is the best.

In welding this case two straight edges would be used one along each side the full length of the case. The pieces that have been cast would be fitted into place and clamped or fastened so as to hold them in alignment. The case would be pre-heated all over until the chill is taken off then confined to that part inside the circle (using the preheating equipment as before mentioned) the flame should be played first on the inside then on the outside expanding the double bottom evenly.

The weld at A would be made first (by the two man system as the writer will call it hereafter) and the preheating flame should be kept on the case all the time. The weld at B would be made next and be made entirely from the one side as it would be impossible to get at it from the other side, the preheating flame would be kept on the underneath or outside during the weld at B so as to keep the bottom half fully expanded. Weld C would be welded next. There should be a spot welded or tacked at the corner D then in the center of the weld at E, start at F and weld up to the top of the case and continue around weld C finishing at D.

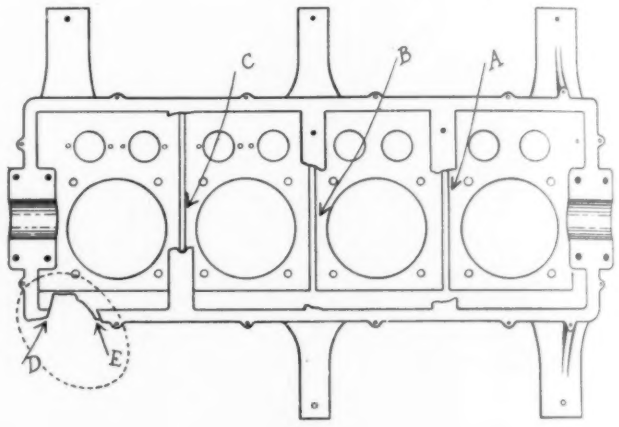


Fig. 2.

To weld a crank case as shown in Fig. 2. The babbot should first be removed from the bearings and a mandrel made of steel tubing the size of the bearings as long or longer than the case would be used in aligning up the broken out bearings and holding them in place during the entire operation.

The shrinkage here is one of the main things to look out for in this piece of work and to take care of this, there must be an allowance made. By placing a thin sheet of asbestos 1/32 in. thick under the mandrel at the two end bearings, it will raise the center bearing 1/32 in. higher than their original positions taking care of the shrinkage. (The bearing caps of course must be put into place the same as if

the crank shaft were being put into the crank case, so as to hold all bearings and mandrel in proper alignment.)

After the bearings have been placed in position for welding, it will then be necessary to pre-heat the case just enough to take off the chill using the same process as described in Chapter 2 (April.) It will not be necessary to heat this case very extensively. Bearing at A would be the first weld to make. Tack the bearing on one side then start at the other side and weld around to the first tack completing this weld.

By using a helper on this job it is done more rapidly and with better results. Bearings B and C respectively are next welded same as bearing A. As each bearing is welded loosen the bearing caps and allow the bearing to settle into its original position, but do not take the mandrel out until the case is finished and is perfectly cold. The arm is now to be welded. Place the arm in position and clamp it there with straight edges, put one along the bottom of the case where the bottom half bolts on, one on the top of the case where the cylinders bolt on and one on the outer edge of the arms. All straight edges should be the full length of the case.

The case should now be pre-heated confining the heat to that part of the case as shown inside the circle, bring the heat up gradually, keeping the arm hotter than the body of the case and leaving the preheating flame on the arm during the entire operation.

In making this weld it should first be tacked on the outside edge as shown at D, then start on the inside upper edge as shown at E welding around the arm the same as with the bearings and finish at D. Keep the arm hot until the weld is as cool as the metal surrounding it, thus eliminating the strain on the weld. Cover with asbestos and allow to cool slowly.

It may be necessary in some cases to allow more or less for shrinkage according to the thickness of the metal. In this instance the case was about $\frac{3}{16}$ to $\frac{1}{4}$ in. thick.

In pre-heating and cooling as heretofore mentioned this prevents the shrinkage cracks which occur when the case is pre-heated all over. As the weld cools before the arm does the expansion of the arm keeps the metal from contracting from both sides of the weld at the same time. After the weld is cool it will stand as much strain as any other part of the case. So by letting it cool before the arm does, it is really stronger than the heated metal, therefore the strain has been removed from the weld and the only expansion left is in the arm. By cooling this gradually the contraction is taken care of very easily. A case welded in this manner has not been subjected to any great danger in warping or shrinking out of alignment as the greater part of it has not been heated very extensively; what heat it has acquired was through radiation. The larger part of the case having been kept cool has held its own shape and made it easier for the operator to handle and has not been in danger at any time of collapsing from handling or from overheating. If this had been pre-heated in a charcoal fire, the chances for warping and shrinking would have been much greater, as the whole case would have been heated to about the same temperature, making it very hard to handle and making it necessary to handle it very carefully, as rough handling under this temperature might cause the case to collapse or if not properly blocked up it could get out of alignment very easily and might not be noticed until the case was finished.

It is also very inconvenient to work over owing to the extreme heat.

From the writer's experience he has found the former to be the most practical way of welding aluminum automobile parts.

SEMISTEEL

In foundry-circles there is now much discussion regarding the properties of what is called by some persons "semisteel," supposed to be produced by melting steel scrap with pig iron, forming a product intermediate in quality between cast iron and steel. Those who approve say that this mixture shows a gain in strength of 40 to 50 per cent over ordinary gray cast iron, and is far more easily machined. Others, however, assert that the steel does not mix perfectly with the pig iron, that the term "semisteel" is imperfect and should not be accepted, and that the product may be, and often is, weaker than good gray-iron castings, instead of being stronger. The term "semisteel," according to these authorities, is simply aiding foundrymen and consumers to fool themselves and each other, and the sooner it and what it represents are discontinued the better.

Representatives of both these views contribute articles to *The Iron Age* (New York, March 2). The defender of semisteel, Mr. Y. A. Dyer, writes as follows:

"The up-to-date foundryman is daily using from 10 per cent to 30 and 40 per cent of steel scrap in his cupola-mixtures and turning out close-grained, tough, clean, and easily machined castings capable of registering tensile strengths of 32,000 to 38,000 pounds per square inch and transverse strengths of 3,500 to 4,000 pounds per square inch, compared with 1,800 to 2,400 pounds in the case of ordinary gray-iron castings. This is certainly an improvement that has never yet been achieved, having in mind machinability, by a mixture of different grades of pig iron, or of pig iron and cast scrap. Therefore, while this improved quality metal may be properly classed, strictly speaking, as gray iron, it so far excels, in strength and texture, the gray iron of the past and present that it is entitled to a name that will place it in an intermediate position between gray iron and malleable iron, just as malleable iron deserves its name to designate a metal that is intermediate between cast iron and steel, and the writer knows of no more appropriate commercial name than 'semisteel.' After all, steel and malleable iron are only refined pig iron—semisteel is only refined cast iron. . . . . .

"In order to get away from the ills of pig iron, neutralizing elements must be balanced. . . . Soft steel is very low in carbon, exceedingly low in silicon (sometimes only a trace), low in sulphur, low in phosphorus, and reasonably high in manganese. Therefore, why should this metal not be an ideal one to supply the deficiencies in a mixture of ordinary pig iron of different grades or pig iron and scrap?

"As to the question whether or not steel will mix homogeneously with pig iron and cast scrap, one has only to bear in mind that pig iron is the mother of both cast iron and steel. . . . By the proper mixing of from 10 to 40 per cent (even 50 and 60 per cent) of steel (low carbon preferable) in the ordinary cupola along with all pig iron of suitable analysis, or pig iron and selected cast scrap, a sound, tough, close-grained, and easily machined casting of high tensile and transverse strength can be produced—especially suitable for cylinders of all kinds (including automobile-cylinders), gears, pinions, piston-rings, liners, car-wheels, plow-points, rams, grinders, crushers, or any high-duty casting."

In the same issue Dr. Richard Moldenke opposes the mixture advocated above, and objects even to using the name that has been given to it.

He believes that the name "semisteel" violates commercial ethics, since, he asserts, the material "has none of the properties of steel that make it distinctive as such."

Every foundryman, he says, "claims to make high-grade castings, whether he uses much or little steel, or none, and the ignorant customer is made to believe and pay accordingly."

Welding of Locomotive Superheater Headers

New Locomotive Superheaters Cost About $130
Broken Ones May Be Welded For About $12.00

By B. Kopferschmidt

It is a well settled fact that the application of oxy-acetylene welding to cast iron are innumerable and varied. It would therefore be impossible to mention all the castings that are being welded with great advantage in the locomotive shops.

Excluding the common castings, such as steam pipes, fire doors, frames, etc., I shall therefore limit my writing to a few that I consider of greater importance and which I have successfully welded.

In considering type K superheater headers, we find that a new one costs $130.00 F. O. B. New York. This cost therefore caused many companies to repair them and to reduce that expense, as well as the loss incurred by waiting for a new casting.

The attempt to weld them, however, has invariably failed and in most cases has been given up. In my experimenting I found that they can be successfully welded at a cost of $11.63 each; that is considering labor and material. The method of welding I employed is simple and in order that the weld should be successfully accomplished, it is necessary to follow out the four distinct processes: Preparation, Preheating, Welding and Cooling.

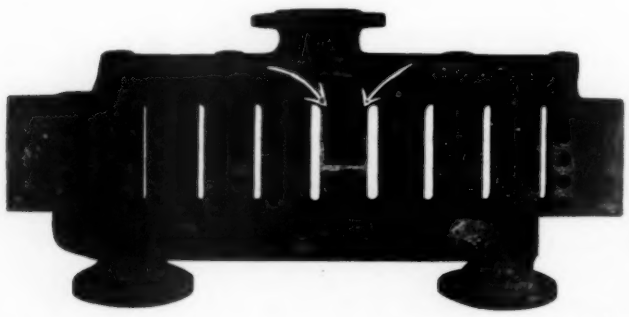


Fig. 1—Locomotive superheater, showing cracks between cylinders.

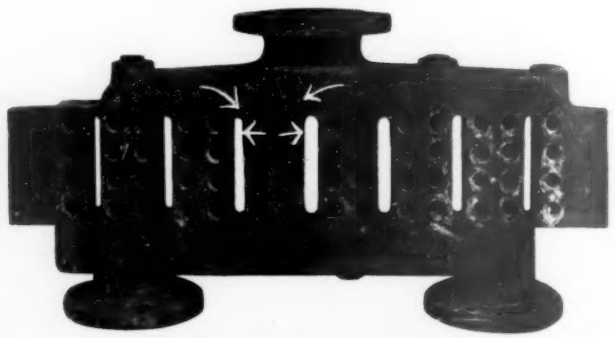


Fig. 2—Locomotive superheater after welding.

In most cases, headers will crack between the sections as shown by Figure 1. Such type of cracks (being the most complicated) will be governed by the following processes:

Preparation

Cut out a rectangular hole on the face of the casting about eight inches long and as wide as the defected section (see Fig. 1); then bevel the edges of both, the hole and the crack from within the section to a 45 degree angle, taking care that when the bevel reaches the other side, it should leave an opening of about 1/8 inch or 1/8 inch. After this operation, fill up the inlet and outlet spaces of the defected section with fire clay mixed with borax. Same could be applied through the hole cut out or through the middle inlet section. This operation is for the purpose of keeping the heat at the defected section only. Then order a cast iron patch to be cut and beveled 1/8 inch smaller than the hole (see Fig. 1); also weld a 3/8 inch cast iron rod on top of the patch, to facilitate the handling of same.

In dealing with this kind of work it is absolutely necessary to have a six or seven foot square welding table, with a sort of crane or chain hoist above it and to see that the casting should be completely welded without removing from the furnace or changing its original set position.

Preheating

Set casting flat on a brisk platform in the center of the table. The height between the base of the casting and the surface of the bricks should be eight inches, thus giving an eight inch fuel displacement; make two brick supports on each end of the casting. As is shown by Figure 1, there are ten sections cast on the header. Of these only three sections are to be preheated, the defected section and the two adjoining ones. Then set brick walls on the width of the casting close to the sections and on the length of the casting. The brick walls should be about one foot distant, thus leaving a fuel displacement of one foot.

In the use of fire bricks it is preferred that the standard ones should be used and that they should always be set flat. The first row of bricks, the one above the platform, should bet set one inch away from each other for draft purposes, and the other rows should be set close. The furnace should reach five inches above the surface of the casting. Then fill the furnace about one-half full of charcoal, followed with a layer of coke (or four shovels); the rest of the furnace should be filled with charcoal. With the use of a lighted welding blowpipe kindle the charcoal through every draft hole and after 20 minutes the furnace should be covered with 1/4 in. sheet asbestos.

In five or six hours the casting will be red hot, ready for welding.

Welding

When the preheated part of the casting is red, remove the top row of bricks from under the asbestos and cut out in the asbestos sheet a hole big enough to clear the hole cut in the casting, place another sheet of 1/8 in. or 1/4 in. asbestos on the side of the preheating furnace fronting the operator, so as to protect his clothes, then light the blowpipe with about 10 lbs. oxygen pressure and commence to weld the bottom crack, or the base of the section (horizontal weld). Then proceed from the bottom up to build up metal on the side cracks of the section (two vertical welds), allowing half inch of metal to extend out from the wall for reinforcement. The building up of the metal should be

continued until the surface is reached. Care must be taken that when the vertical welds are made that the joining of the metal is perfect, and not to overheat the blowpipe. To overcome this latter difficulty the blowpipe should be thrust into cold water every five or six minutes. Now put the patch into the hole and replenish the furnace with about four more shovels of charcoal; cover the furnace with asbestos and allow it to heat for one hour.

At the end of the hour remove the asbestos from the hole and with 16 lbs. oxygen pressure on the blowpipe proceed to weld the patch with ⅜ in. cast iron rods, to be welded in three lengths to facilitate handling; if possible, use a long handled blowpipe and two pairs of asbestos flannel lined gloves. When one pair gets too hot the operator may change for the other. The gloves should never be thrust into water as it will form steam and retard the operation.

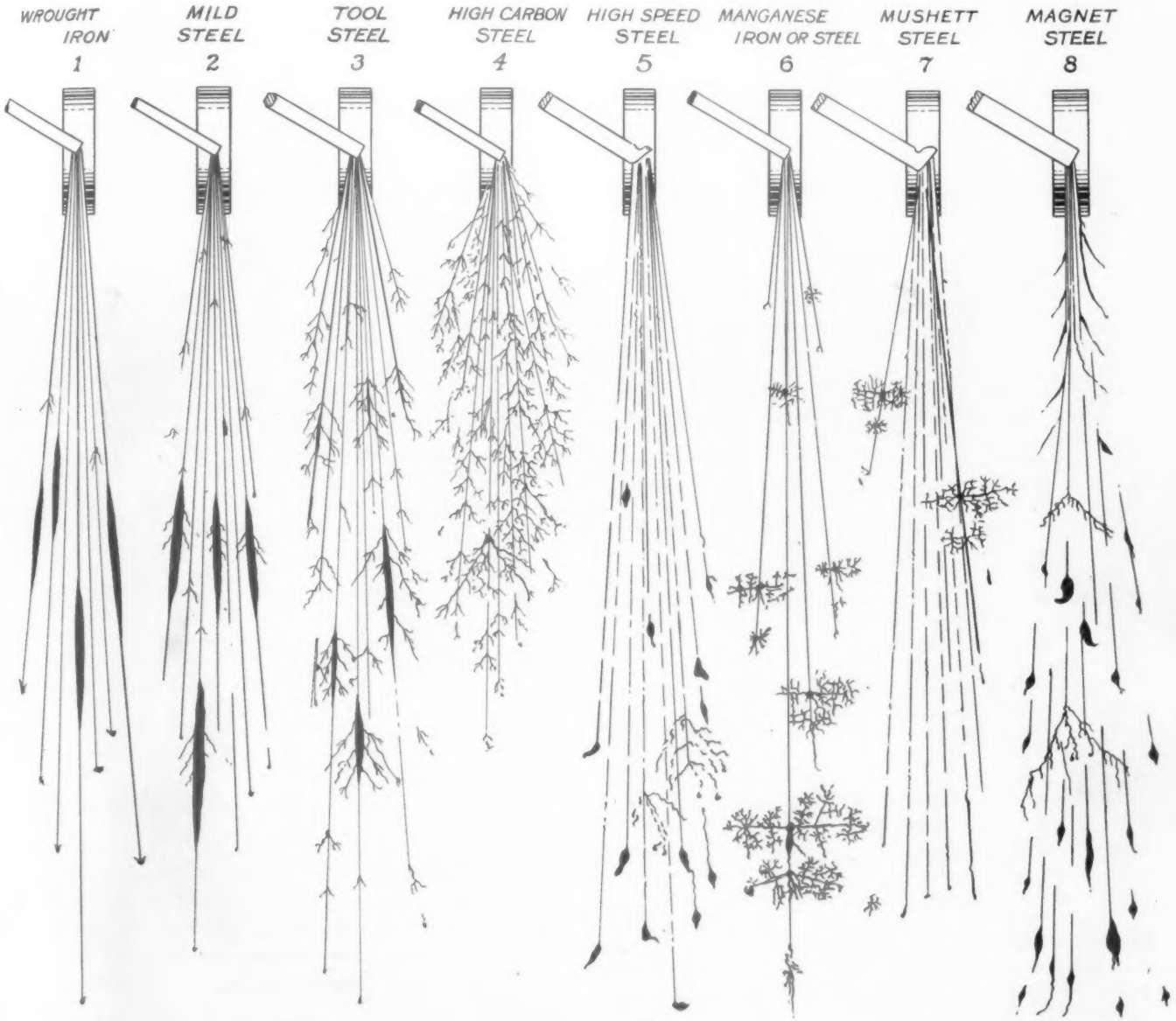
Cooling

When the welds are completed, two shovels of charcoal are added to the furnace and it is covered tight with the asbestos, by placing a row of bricks on top; then close all the draft holes and any crevice that may be found with fire clay and allow the furnace to cool at least 40 hours. Then remove furnace and the casting is ready for machining.

SPARK METHODS OF SELECTING IRON AND STEELS

The welder is often at a loss to determine the exact quality of a piece of metal, and if a successful weld is to be secured this forehand knowledge is necessary. Mr. John F. Keller, instructor in forging at Purdue University, Lafayette, Ind., has worked out a useful method, which is illustrated on this page. Accompanying this illustration Mr. Keller makes the following observations:

Fig. 1. A piece of wrought iron free from carbon. If held against the emery wheel the end of the bar will be heated by friction; as the small particles are thrown from the wheel they will follow a straight line which becomes broader and more luminous some distance from the source



Copyrighted by John F. Keller.

of heat, and then disappear as they started. This is probably due to the action of oxygen of the air on the heated particles requiring some time to act.

Note: Touch material lightly on wheel; observe individual spark.

Fig. 2. Mild steel which contains a small percentage of carbon. The effect is at once noticeable by a division or forking of the luminous streak; this is owing to the presence of carbon which is acted upon by the maximum heat of the iron spark, which then burns explosively causing a break in the original heavy lines.

Fig. 3. The lower grades of tool steel which contain from 50 to 100 per cent point carbon. The iron lines become less and less conspicuous, the forking of the luminous streak occurring very much more frequent, often subdividing; the lower the carbon the less sparks and further from the source of heat.

Fig. 4. In the higher grades of carbon steels the iron lines are practically eliminated, with an increase of the star-like explosions which often divide and subdivide, causing a beautiful display of figures. This is probably due to the iron and carbon becoming so united that they are most easily attacked by the oxygen. Hence the great danger of burning steel in the fire. It would be well to state that the higher the percentage of carbon the more profuse the explosions and the shorter the distance from their source of heat.

Fig. 5. Chromium and tungsten high speed steels are very easily determined by the spark test. The particles seem to follow a broken line with a very slight explosion; just before they disappear the color is of chrome yellow—and show no trace of a carbon spark.

Fig. 6. Manganese in tool steel above a certain per cent is a very injurious element. The characteristic of the manganese spark is that it widely differs from the carbon spark in that it seems to shoot or explode at right angles from its line of force. Each dart is subdivided into a number of white globules. With a little practice the trained eye will soon detect the slightest trace of manganese in the iron or steels.

Fig. 7. Mushett steel, the grade of air hardening or high speed steel.. It is very easy to distinguish from other steels as the particles follow a broken line and are a very, very dark red, with an occasional manganese spark.

Fig. 8. Represents the spark as thrown from a special steel manufactured, and to be used especially for magnets. It clearly demonstrates the advantage of this method of selecting steels by comparison; in other words, mark your favorite brands or grades and compare them with others. By practicing this method there will be less taps and reamers made out of machinery steel, with a corresponding decrease of forging made out of metals that are too high in carbon.

WELDING FLUES BY ELECTRIC ARC PROCESS

By J. H. Bryan*

In a recently published article, evidently written by one who apparently has not had a very broad experience with electrically welded flues, the statement was made that welding flues by the electric arc process results in a large number of cracked bridges. A further statement was to the effect that these cracked bridges could be only temporarily repaired by electric arc welding. Such statements are grossly misleading.

Investigation among a number of prominent railroad companies doing flue welding by the electric arc, discloses the fact that they have not encountered the faults complained of. In some few cases cracked bridges have been found in flue sheets where the flues were welded in, but the percentage of these cracked bridges has been no greater, and has usually been less, than where the flues were put in in the ordinary manner. The experience of these companies leads them to believe that if correct methods are used in flue welding, the number of cracked bridges will be less than where flues are put in without welding. There will be, of course, cases where, due to inexperience, an operator will turn out a boiler which will in a short time show leaky flues or cracked bridges. Evidently, however, this should not be charged against the process of flue welding in general.

In practically every case where trouble has been experienced with cracked bridges, it can be traced to bad water conditions, whether flues are welded or whether they are put in by the older method of rolling, beading, and prossering. This trouble is due to the accumulation of scale over the water side of the flue sheet and cannot be chargeable to the methods used in putting in the flues.

In connection with the statement that cracked bridges can only be temporarily repaired, it might be interesting to know that one large railroad system has been welding flues and repairing cracked bridges on flue sheets by the electric arc process since 1912, and out of a large number of cases has found but one case of failure.

After an investigation to determine the best method of welding the flue to the sheet, the experience of one large railroad has convinced them that the most satisfactory method is to do a straight job of welding, using no copper ferrules, and eliminating entirely the operation of beading. It has also been found that the voltage across the arc has a great deal to do with the quality of the work turned out. A difference of only 3 or 4 volts across the arc means success or failure insofar as obtaining a uniformly good job is concerned. Experience indicates that the shortest arc that can be maintained gives the best results. The current, too, should be kept as low as possible. Further, it is absolutely essential that the flue sheet and flue ends be thoroughly cleaned before welding is started and that all traces of grease or oil be removed. Sand blasting has been proved a very satisfactory method for doing this cleaning work.

Flue welding is being done by nearly every large railroad shop in the country at the present time. Almost without exception this welding is being done by the electric arc process using metal electrodes. One of the great advantages of welded flues lies in the fact that the results obtained are practically permanent, as the flue and sheet are bonded together without a joint. This means that the maintenance of flues will be very greatly reduced, as the constant attention required to keep unwelded flues tight is practically eliminated. In districts where scale does not make necessary their earlier removal, cases have been known where flues have gone up to the three-year limit without any attention other than an occasional inspection.

The almost universal success obtained with flue welding would indicate that where unsatisfactory results are obtained the methods used should be thoroughly investigated. Every effort should be made to insure that the proper procedure is being actually followed by the operator doing the work before the process of flue welding is condemned.

*Westinghouse Electric & Mfg. Co.

NEW BOOKS

"Automobile Repairing Made Easy," is the title of a new book just published by The Norman W. Henley Publishing Co., New York. There are more than 1,000 pages, price $3. There are fourteen chapters, covering in detail every feature of automobile repairing. Chapter 10, which is devoted to miscellaneous repairs, covers also oxy-acetylene welding, preheating, etc.

WELDING STELLITE

Stellite is the trade name for a new metal which is meeting with remarkable success for cutting metal at high speed.

Stellite is an alloy of semi-rare metals, discovered and patented by Elwood Haynes, of Kokomo, Ind., a metallurgist of international repute, and the "Father of America's first gasoline automobile."

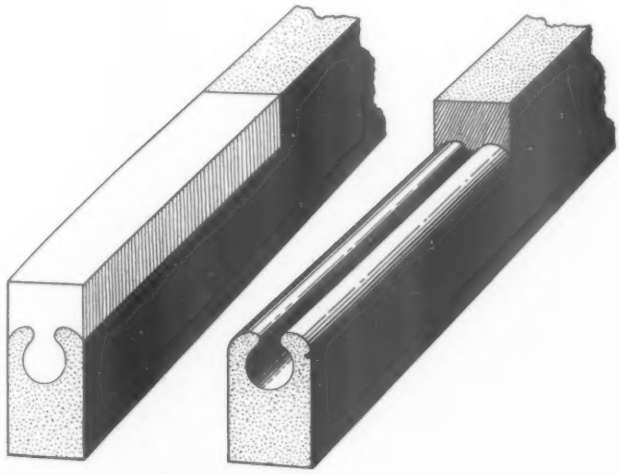
This alloy is not steel, since it contains no iron. If iron were introduced into the mixture, its cutting properties would be greatly impaired.

"Stellite" is derived from the Latin word "Stella," a star, because when the alloy is polished, it takes a beautiful silvery color and luster, and always continues to shine.

The various Stellite alloys resist oxidation or tarnishing better than any known metal excepting gold and the metals of the platinum group.

When Stellite is heated to dull redness, it becomes covered with a light film of oxide which gradually deepens as the temperature increases, finally resulting in a deep blue black. The metal does not oxidize deeply even at a white heat.

In color, the polished metal stands between silver and steel. It rivals silver in brilliancy and luster to such an extent, that its star-like brightness suggested the name of Stellite.



Method of casting Stellite tools.

Stellite is absolutely immune to all alkaline solutions, and practically so to all chemical salts, including solutions of bichloride of mercury, iodine, etc.

What high speed steel is to ordinary steel, Stellite is to the best high speed tool steel. Stellite marks a new epoch in cutting metals and is so superior to all other metals, especially for "Production Work" that there is no comparison to make, a fact demonstrated by repeated tests in this and foreign countries.

The reason Stellite tools cut so much faster than steel, is because they are so much harder and tougher and are not susceptible to heat. Stellite does not lose its temper even at a bright red. An intense heat will soften Stellite, but as soon as it cools it regains its original hardness. These tools cut when red hot just as well as when cold.

The stellite alloy used for machine tools is cast in the required shape and form and the user can then grind them to the dimensions desired on either a carborundum or alundum wheel.

This metal is cast in bars, not over fourteen inches in length, in all the standard tool bar sizes. These bars can be ground to a cutting edge, according to directions furnished with the tools.

The advantage of Stellite tools lies in their ability to cut metal from 10 per cent to 300 per cent faster than any other tool, so to obtain results, speed up your lathe or machine.

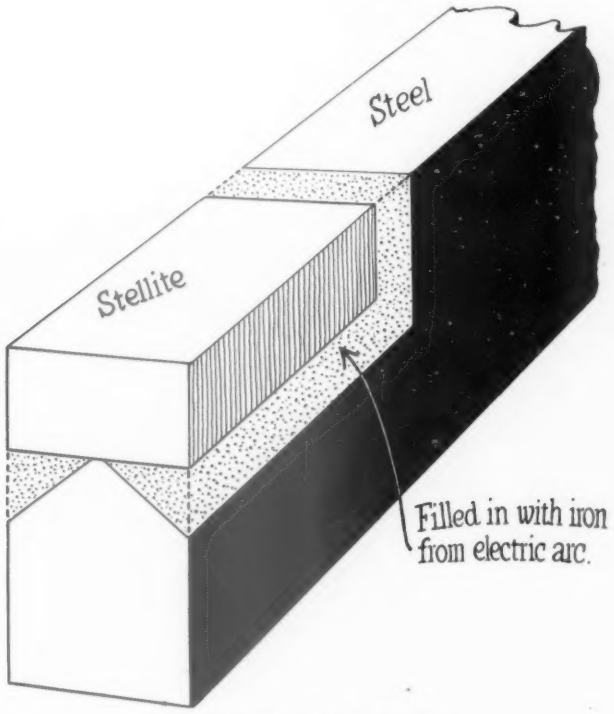
If the lathe will not pull the desired cut at high speed, place a larger pulley on the line shaft to speed up the countershaft.

Stellite tools will work under slow speed, and heavy cuts just the same as steel tools, but under these conditions they show no decided advantages or economy, except as to grinding.

Use the same depth of cut and feed with Stellite tools that are used with high speed steel tools.

Stellite bars may be readily cut to length by grinding a deep notch completely around the bar, placing in a vice and breaking with a hammer.

As will be noted from the accompanying illustration the "cast-on" type of tool. Until recently it was considered that this metal could not be welded successfully, but recently at least one concern in Cleveland has successfully spot-welded Stellite, and in the following letter the manufacturer says:



Method of arc-welding Stellite tools.

"A number of our customers use the acetylene, also the spot-welding process in welding Stellite to steel shanks. However, we never thought very much of either process because, while the tool produces excellent results, its general appearance prevented it being a marketable article.

"Recently we have discovered a means of arc welding Stellite to steel that not only makes a mechanically perfect tool, but also makes a very sightly one, and a tool that will appeal to any buyer or mechanic.

"One of the electrodes is attached to the steel shanks. The other electrode is fastened by a suitable clamp of short length soft iron wire. An arc is formed at the juncture of the Stellite and the steel. The heat of the arc melts the iron, and the iron fuses the Stellite to the steel, filling up the V-shape depression, firmly cementing the two parts. After the tool is cold it is ground and it is hard to detect where the Stellite and steel is joined."

Welding Sheet Aluminum in the Automobile

By C. R. Sutton

In the palmy days of the horse drawn vehicle, Amesbury, Mass., was a mecca for the carriage industry. With the advent of the automobile, what was more natural than the development of an industry more in keeping with the trend of the times? The carriage industry in the Amesbury of today is to a large extent replaced by factories devoted to the manufacture of automobile bodies, their products outrivaling in fitness of appointments and fineness of finish and design the most luxurious wooden coaches of old.

In Amesbury, some rather remarkable methods of aluminum body construction have been developed, which have made possible radical departures in design, savings of material through the more economical cutting of patterns and savings in actual labor costs as well. Oxy-acetylene welding plays an important part in this new type of body construction and a visit to the plants of the Walker-Wells Company, a development of the Walker Carriage Company—manufacturers of carriages for more than twenty-five years—disclosed many new and interesting applications of this modern process of uniting metals.

For example, in the manufacture of the Franklin roadster body, the back quarter panels, consisting of a solid piece of sheet aluminum extending from the door opening on one side around both quarters and across the back could be constructed in no other way except by welding. The entire section, welded into one solid piece without a seam, is shown in Fig. 1.

The unpainted Winton Berlin body, shown in Fig. 2, illustrates another important saving effected by oxy-acetylene welding. In this type of body, the top is constructed of aluminum and is welded to the back panel so as to form one continuous piece. This top, as well as the various other patterns, may be made up from several plates welded together, thus obviating the necessity of using large sheets of aluminum, thereby reducing the cost, and in some parts admitting the use of various small pieces of sheet aluminum that would otherwise become scrap, again effecting a considerable saving. The construction of a center post panel from four pieces of stock of odd sizes is shown in Fig. 3. Welding time on this type of panel construction is five minutes.

The forming of the cowl on the Franklin bodies formerly presented many difficulties, due to the large amount of metal that must be formed and swaged over the front to form the front panel of the cowl. This difficulty has been overcome by the welding process as shown in Figs. 4, 5 and 6. Fig. 4 shows the cowl hammered to shape with very little metal formed over the front. The balance of the front panel is made up by welding in small side sections or wings, as shown in Fig. 5. This view also shows the complete outfit used in all of this work, consisting of a cylinder of acetylene gas, a cylinder of compressed oxygen, both mounted on a portable truck, and a blow-pipe, which is especially adapted to the welding of sheet aluminum. Fig. 6 shows the completed weld, the front panel sections now conforming with the characteristic lines of the Franklin hood. The total length of this weld is approximately sixty inches and the total welding time for both sides is seven minutes.

Two views of the Franklin roadster rear boot, welded into one solid piece, are shown in Figs. 7 and 8. The total time for these two welds is eight minutes. The same class of work on a coupe rear boot is shown in Fig. 9, the welding time of which is much shorter, being only five minutes. Welding of this character is carried out with the separate parts clamped on a frame as shown in Fig. 10.

Another operation which formerly presented difficulties in automobile body manufacture is the forming of door panels around the window frame openings. This was formerly handled by slowly hammering the metal over the frame and carefully working in the corners, the process occupying a total time of over two and a half and sometimes three hours. Even by proceeding slowly and exercising the greatest care in the forming of the metal at the corners, it was found that cracks would appear at various places in the metal, due to the strain of working the metal cold. A considerable loss of material was the result in a great many instances.

This difficulty is now overcome by using a small acetylene blow-torch, which is similar in principle to the well-known bunsen burner. The metal is simultaneously annealed and hammered by one man as shown in Fig. 11. In this case the same cylinder of acetylene that is ordinarily used with the oxy-acetylene outfit is being used to furnish gas for the annealing and hammering operation. The total time occupied by this newer method is thirty minutes, at a time cost of less than one-fifth of what the old method of hammering cold formerly cost, and with practically no loss.

A striking example of the savings that are being made in the laying out of patterns on aluminum sheets is given in Fig. 12. The illustration is of a Sedan cowl, roughly shaped, with small pieces welded to the corners—a considerable saving in the size of the sheet necessary for this pattern. The total time consumed in welding the two corners was five minutes.

Various other parts not illustrated are welded in this interesting industry and the oxy-acetylene process also finds many other important uses on general welding work about the plant.

For the benefit of those who are not familiar with the welding process, a detailed explanation of the method of proceeding with this class of sheet aluminum welding will prove interesting and instructive. In the majority of operations, the edges of the sheets to be welded are turned at right angles to a height from one and one-half to two times the thickness of the metal. After applying a flux to cause the metal to flow freely, in a manner described later, these upturned edges are brought together and held with clamp

Fig. 1—Back quarter panels of Franklin roadster, welded at points marked "A." Time, 4 minutes.

Fig. 2—Winton Berlin body before painting. Top and center post panels are welded.

Fig. 3—Center post panel of Winton Berlin body, welded at points marked "A" from odd sizes of stock. Time, 5 minutes.

Fig. 4—Franklin cowl before welding.

Fig. 5—Operator welding in front panels of Franklin cowl. Note method of holding sheet in position for the weld. This also illustrates the complete oxy-acetylene welding outfit.

Fig. 6—Front panels welded into Franklin cowl to meet lines of sloping hood. Two welds indicated by letters "A" and "B." Time, 7 minutes.

Fig. 7—Rear boot on Franklin roadster. Two welds, indicated by letters "A" and "B." Time, 7 minutes. Page 26.

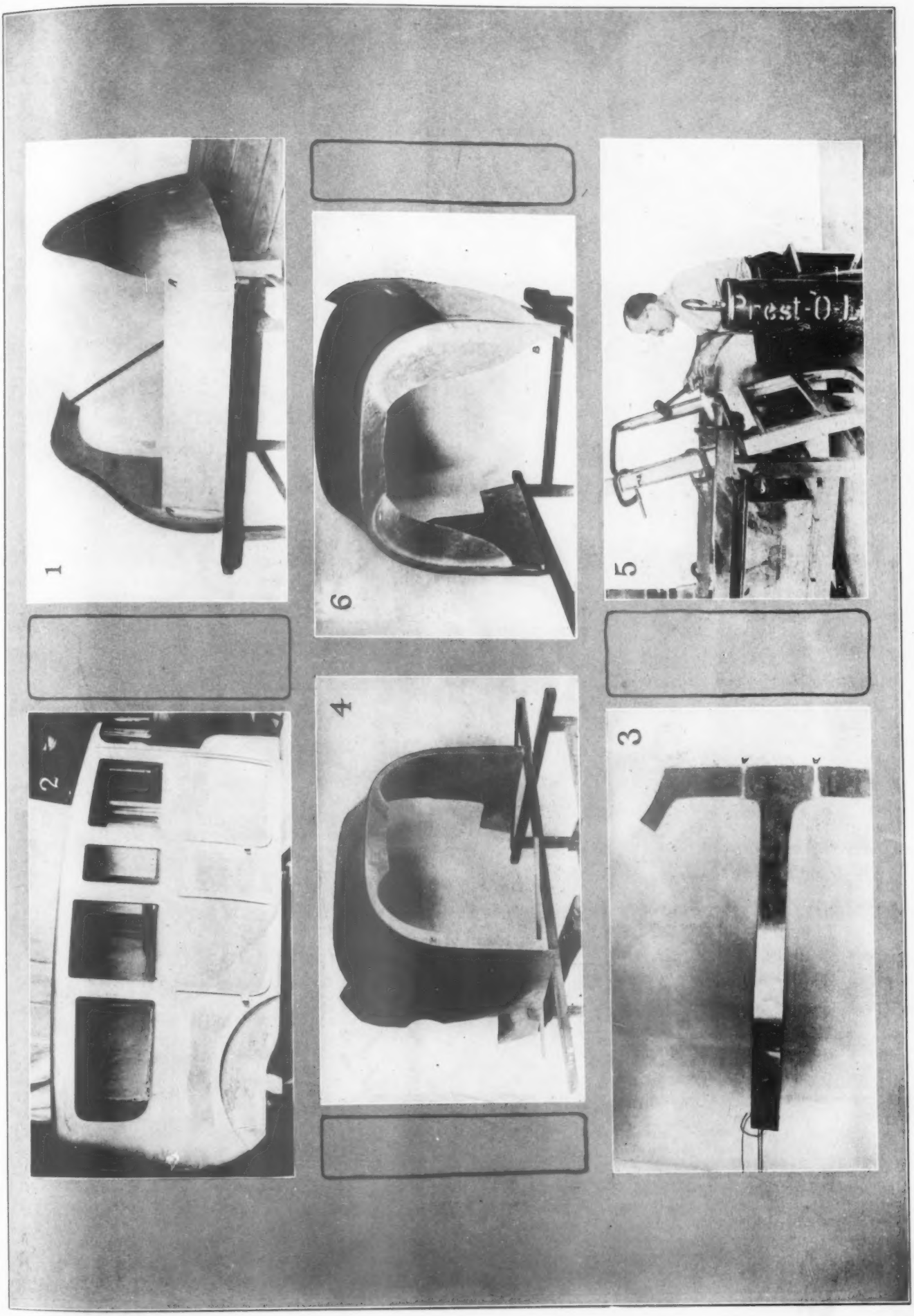
Fig. 8—Another view of roadster rear boot. Two welds, indicated by letters "A" and "B." Time, 7 minutes. Page 26.

Fig. 9—Coupe rear boot, welded at points indicated by letters "A" and "B." Time, 5 minutes. Page 26.

Fig. 10—Method of clamping aluminum sheets in position for welding sections of coupe or roadster rear boot. Page 26.

Fig. 11—Annealing aluminum window frame opening by means of acetylene blow-torch to facilitate hammering over frame without cracking. Page 26.

Fig. 12—Small pieces of aluminum sheets welded to corners of Sedam Cowl, saving considerable material in the layout of this pattern. Welds are indicated by letters "A" and "B." Time, 5 minutes. Page 26.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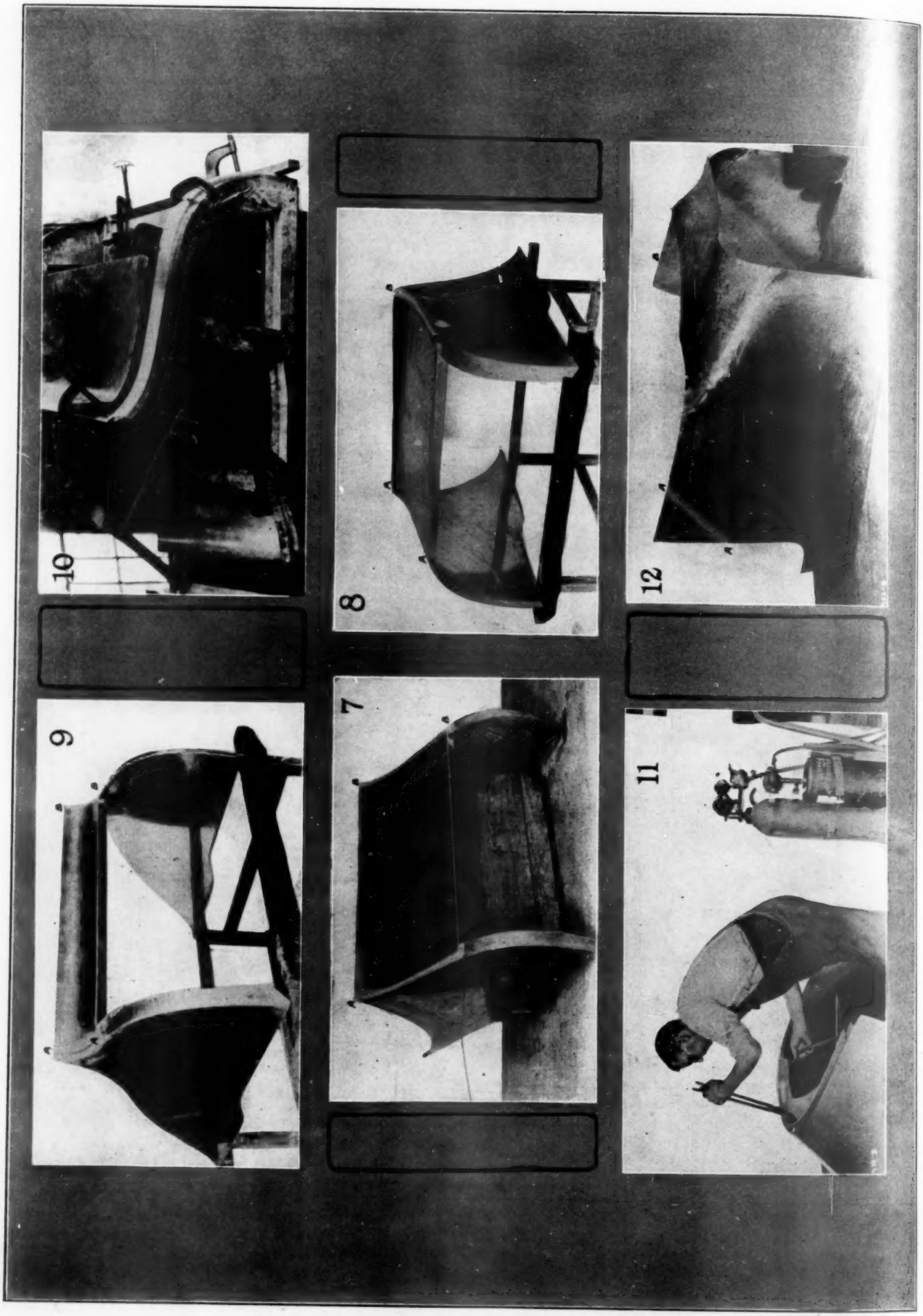
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tongs such as are being used by the operator in Fig. 5. A short section of a few inches is then welded.

This welded section is allowed to cool thoroughly before removing the clamp, otherwise a crack would develop which might follow the subsequent welding, as aluminum when subjected to intense heat is very fragile. The tongs are then moved a few inches along the line of the weld and the metal welded to that point. This is continued until the entire section has been joined.

The part not yet welded is allowed to hang free, or is held by a helper, according to the size and shape of the sheets. Oftentimes the helper assists the welder by manipulating the free ends of the unwelded portion by bringing them into their true relative positions as the clamp is moved along the line of the weld in advance of the welding operator.

Preliminary "tacking" of the joint at regular intervals, with the welding flame, except at the point where the weld is begun, is not considered good practice as it has a tendency to cause a "buckling" of the sheets as the weld progresses which interferes with the progress of the operator and nearly always results in bad workmanship.

The proper use of a fluxing agent is one of the most important points to be watched in sheet aluminum welding. Its improper application nearly always results in imperfect work. The following information will prove useful to welders engaged on sheet aluminum work.

A special sheet aluminum flux, mixed with water to the consistency of cream, is applied to the line of the weld by means of a stiff brush similar to a painter's "sash tool." After the weld has been completed the flux is washed off either with a scrubbing brush or, as is more commonly the case, with a bunch of waste soaked in cold water, the water being applied freely.

It is necessary to remove all of the remaining flux from the line of the weld and the adjacent metal for the reason that practically all aluminum fluxes contain chlorides and aluminum is very susceptible to the action of the chlorine, either in the free state or in combination with other elements. This causes corrosion which may not appear until after the body has been painted, when it will cause the paint to peel.

Not all fluxes can be used in a wet form, but in the event that a dry flux is used the same precautions in regard to removing all traces of the flux apply. It is customary to have a pail of water handy so that the scrubbing may be done immediately upon the completion of the weld.

Care should be taken not to "trap" the flux in the weld, in which case no amount of scrubbing would remove it. By "trapping in the weld" is meant the flowing together of the metal in the joint above and below the flux so that the flux cannot be entirely burned out.

An advantage in using flux in a moist condition is that, when applying the first coat with a piece of cloth, both edges of the metal must be rubbed to a distance of about ⅜ of an inch, which operation effectually removes any oxide from the surface of the metal and also destroys any greasy material which might form a film over the molten metal. After this is done a second coat should be applied sparingly with the stiff brush.

No filling material is used in the welding operation except at such points as a defect may occur, through either the improper handling of the welding flame or lack of a sufficient quantity of flux to allow the metal to flow together freely. In this case, usually a narrow strip cut from the same metal is used as a filler and the operator refluxes the line of weld before starting to fill in the defective spot.

After welding, the line of weld is hammered flat under spring power hammers, similar to those used for flat hammer work in all sheet metal industries.

A small welding blow-pipe for use in this class of welding is peculiarly adapted to sheet aluminum welding on account of its small size (weighing but a few ounces) and its easy manipulation. With it a workman can weld thin sheets more rapidly than with the heavier type of blow-pipe such as is commonly used in large repair work.

WELDING LOCOMOTIVE SUPERHEATER UNITS

By H. S. Mann*

Many of the locomotives on steam roads are now equipped with superheaters for the purpose of superheating the steam and obtaining an increase in power of the locomotive. These superheaters also permit of reducing the boiler pressure which, of course, reduces the cost of boiler maintenance and lessens the cause of explosions.

There are a number of different kinds of superheaters manufactured, but I have in mind one which is used extensively and considered very satisfactory. In the construction of this superheater there is a header connected to the dry pipe and to the steam chest for valve chambers. From this header there are pipe coils for so-called superheater units which extend into the large flues of the boiler which are provided for the purpose. One side of the unit connects to that part of the header which moves live steam from the boiler to the dry pipe, while the other side of the coil or unit connects to that part of the header which conducts the *steam* after being superheated to the steam chest or valve chambers where it is admitted to the cylinders.

Like almost everything else, these units become worn and burned out. This usually occurs at the bends and in some cases the joints which connect the unit to the header will break off. When such accident occur, instead of scrapping the unit as has formerly been necessary, a new bend is provided and welded on by the Thermit process. The burned-out or broken part is cut off so as to leave only about 6 in. of straight pipe. The new part can be welded on to this very easily and at moderate cost. The operation saves the unit and considerable money at the same time.

The Thermit process as applied to pipe welding is used in making these repairs and offers the advantage that the weld can be made without in any way reducing the inside diameter of the pipe or restricting the flow of steam. Neither is there any obstruction on the outside of the unit after welding to impede the passage of hot gases through the flues.

The Thermit process for pipe welding is simple and inexpensive while the equipment is light and portable and can be carried by one man and helper to the work. This is a great advantage, as many times it would be inconvenient to bring the work to the equipment. No outside power or heating apparatus is necessary, the Thermit welding portion creating its own heat. This is made up for the size and weight of pipe to be welded and simply acts as a heating agent to bring the ends of the pipe to be welded to welding heat. This is usually accomplished in 1½ minutes after the products of the Thermit reaction have been poured into the mold surrounding the joint to be welded. As soon as the ends of the pipe are heated sufficiently one complete turn is taken on the clamps holding the pipe ends together, and as soon as this has been done the clamps and mold are removed. All the Thermit steel and slag then falls off of the welded pipe, leaving a good clean surface. The pipe is completely welded and fully as strong at the weld as in any other section. There is nothing about this operation which cannot be mastered by any good pipe fitter in a very short time.

This process is now being used by a number of steam railroads, not only for welding superheater units but for welding air, hydraulic and high-pressure steam lines as well, doing away with couplings and flanges and thereby eliminating many leaky joints. The process also permits of obtaining the benefit of the full weight of the pipe due to the fact that the cross-section has not been reduced or cut nearly one-third by threading.

**District Manager, Goldschmidt Thermit Co., Chicago, Ill.*

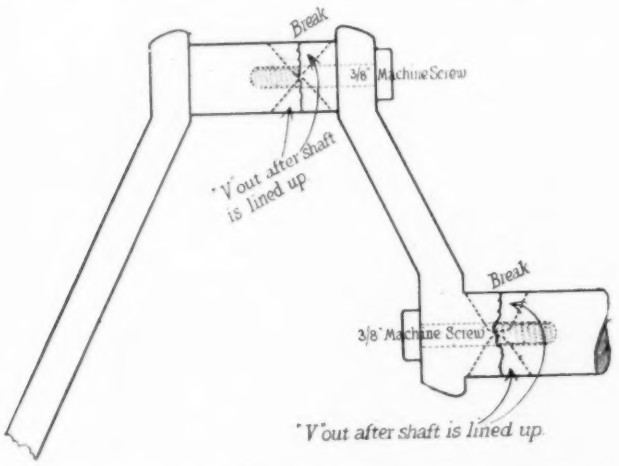
Hints for the Welder

Practical suggestions from practical men. Contributions to this department solicited.

Editor:

We have had some interesting experiences in overcoming the difficulties of welding crank shafts. In all cases it was found that the shaft was out of line when the weld was completed. The enclosed sketch will show how we have overcome this difficulty when the break is in the bearing.

The broken parts are centered and drilled to be tapped for a ¼" stud bolt. One of the broken parts is drilled through the web with a ¼" bit, the other part of the break is only drilled about ¾" with a 11/64" bit. This smaller hole is then tapped with a standard ¼" top. The broken parts are then fitted together and drawn up with the stud. This will hold the shaft in alignment for the balance of the operation. Care should be used in drilling the holes; it is best to do this in a lathe. If the holes are out of line, off center or made at an angle your shaft will not be in alignment. The shaft is then scarfed out on two sides only. For this use a ¾" bevel edged wheel. An honest mark of about 1/16" should be left in the center of the shaft. This



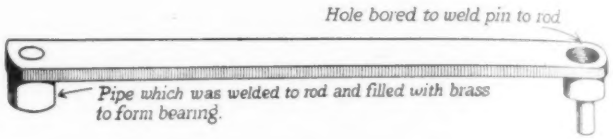
amount of stock is usually sufficient to hold the average shaft in line while making the weld. The shaft is now placed in "V" blocks and the weld executed in the following manner, using a filler rod especially adapted to welding drop forgings.

Preheat the joint until the surfaces to be worked have come to a white heat. Now start your welding by first melting together the edges of the break. This should be done on both sides before adding any of the filling rod. By adding a little of the rod alternately to each side the expansion will be even, the piece will not have a tendency to warp and will stay in line. When this weld has been completed cup off the head of the stud and weld over this surface. While still hot bury the piece in slaked lime and allow to cool very slowly.

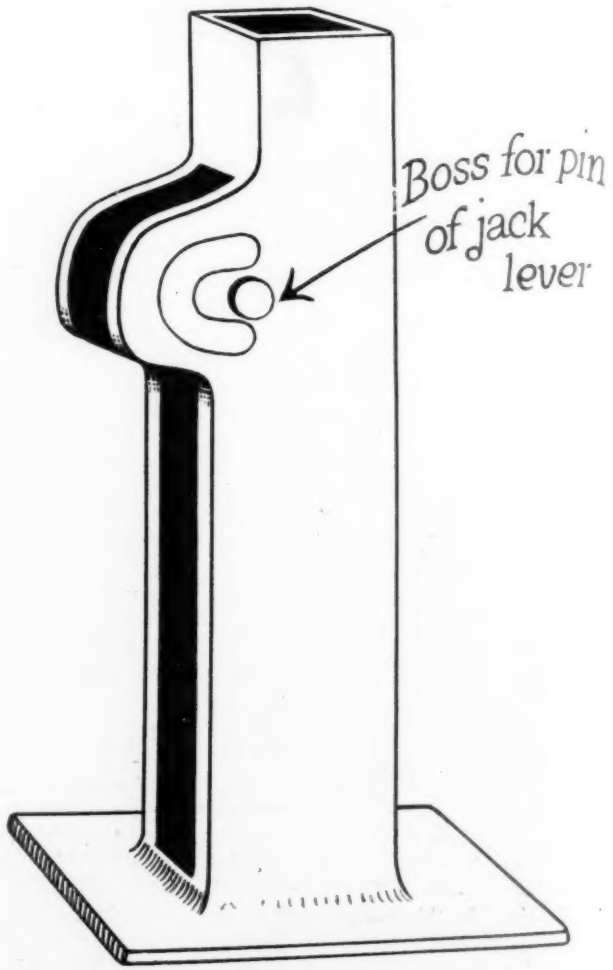
Crank shafts welded in this manner are seldom found to be out of line when placed in a lathe to be turned up.

LEO A. BARON,
Elkhart, Ind. Mgr. The Elkhart Welding Co.

Editor: While building an experimental machine recently, I needed several arms with a pin on one end and on the other end a bearing with a boss on the side of the rod. The bearing was to be bushed with brass. I could not wait for the blacksmith to forge the arms out, so I turned to my torch for a way out of the difficulty. I took a piece



of flat iron the size of the rod required and procured a piece of iron pipe large enough to form the size of the boss required, and laid it on the end of the rod and welded it up and filled the inside with brass which formed the bearing. On the other end where the pin was to go I drilled



a hole and countersunk on the rod almost the size of the pin head and that formed the recess for welding it to the rod. Have also used the above method of building bosses

on cast iron jack frames, and have secured a neat and strong job with very little trouble.

A. H. YOCH.

700 Locust St., Hasleton, Pa.

Editor: No doubt the reader has had some experience in welding automobile cylinders, where the piston head was pushed up through the inside of cylinder. It is a very delicate job, although practical if handled right. First, take all valves springs, plugs and pet cocks out of cylinder and cut off outside jacket, leaving at least half inch away from break on inside. The cutting may be done with drill, saw or diamond point. Then take the broken pieces, cleaning them well by emery wheel or file, place on welding table and spot them together in their proper place. Then bevel edge of pieces to 45 degrees, also clean and bevel edge of cylinder where broken. Place the pieces spotted together in place on cylinder, then preheat cylinder until almost a red or high black heat, either by charcoal or gas preheater, and leave same right in fire while welding, and until cool. Take out and test by pouring gasoline in bore, then preheat as before for welding on part cut off, always placing bottom of cylinder on fire. Laying on side will warp and change bore, and will make it necessary to rebore and use over size piston. READER (A).

Editor: We are enclosing herewith some rough drawings of a cylinder. This is supposed to represent a cylinder with a lug broken off. In Fig. 1, the cylinder is shown with the lug in position, the cylinder supposedly resting on a surface plate. Now this welding is usually done on the outside, a fillet being added where the lug joins on to

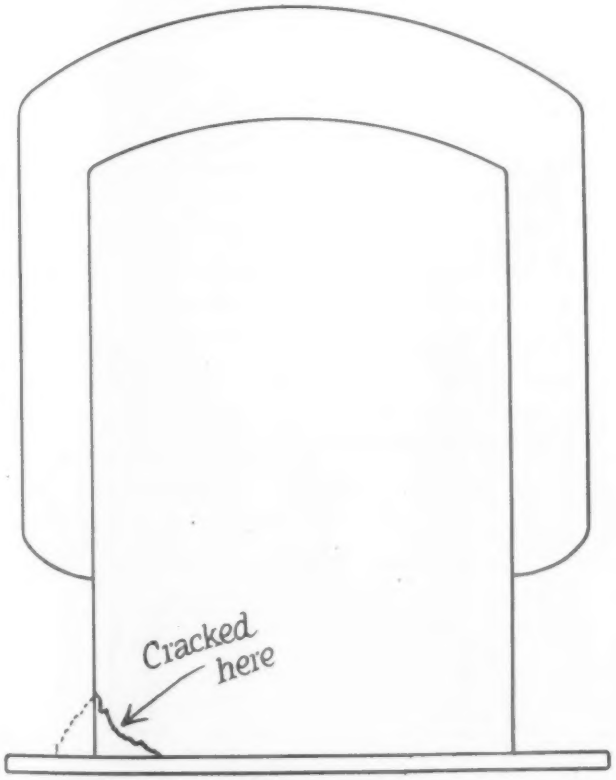


Fig. 1

the cylinder body. Now this fillet is formed by the addition of molten metal and when it cools it contracts somewhat, with the result that this lug is pulled up as shown in Fig. 2. This rough drawing is exaggerated, of course, but it will pull it up and as the base of this cylinder must be true it means that a cut would have to be taken off the entire base. This is expensive and bothersome. The way we do this is to set the main body of the cylinder on the

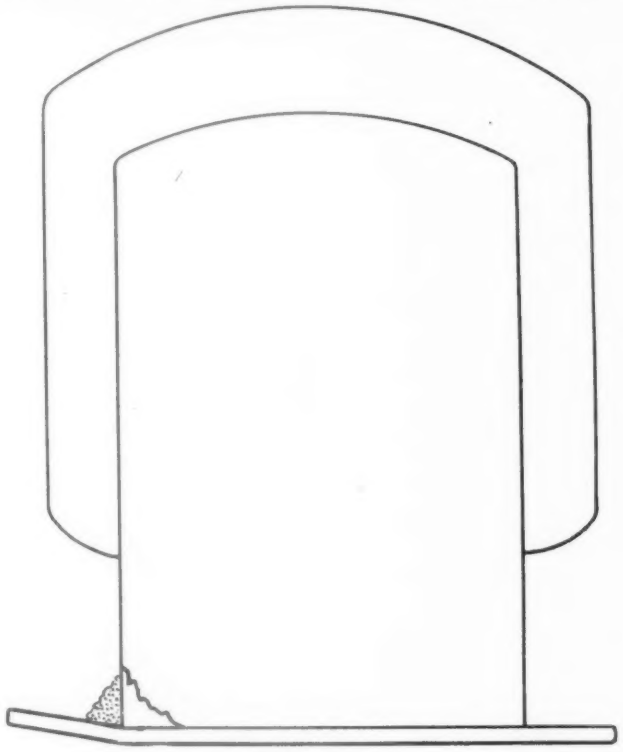


Fig. 2

surface plate, first placing underneath it about three thickness of brown paper. We then place the lug in position without any paper under it. This means that when welding is started the base is not true, but is low on the broken lug corner. Exaggerated, this is shown in Fig. 3.

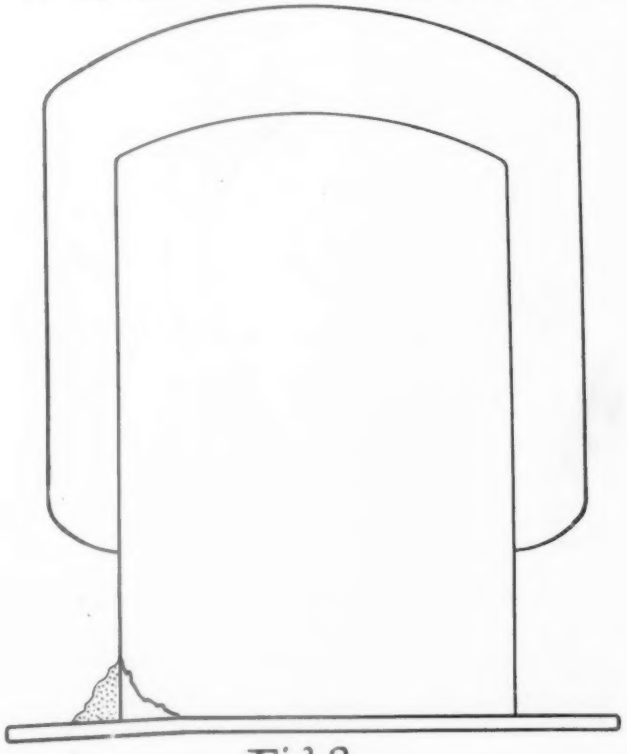


Fig. 3

The welding is done on the outside and the fillet added,

and when it cools it will pull this corner up practically true so that in the majority of cases no machining work is necessary. If it should not pull it up absolutely true, then all that is necessary is to file off this one corner, which can be done in a very few minutes.

P. F. WILLIS, President.

Henderson-Willis, W. & C. Co.

Editor: A short time past the writer was called to a local factory, and confronted by a task described in the accompanying sketch, which shows a blast furnace used for melting aluminum, and found the edges of door 'a, burned so bad, by the blast escaping under door, that the door very

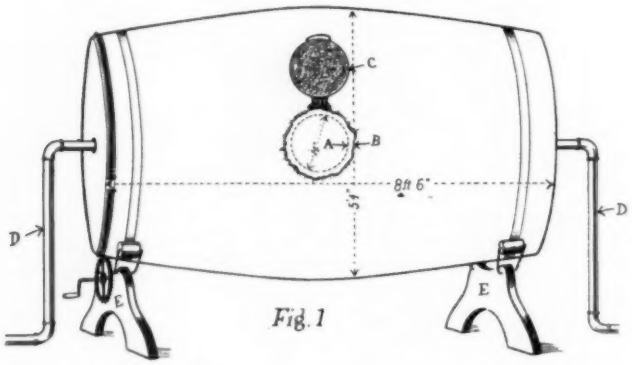


Fig. 1

near fell through, when in a closed position. This is a steel furnace weighing about 1¾ tons, and the writer was supposed to bring the opening 'a, back to the original size of 14 inches. The edges of this opening was burned away until it measured nearly 18 inches across.

On account of the weight of this furnace it was decided to do the job "on the spot," without dismantling. Having a blacksmith and machine shop in easy reach, an 18-inch

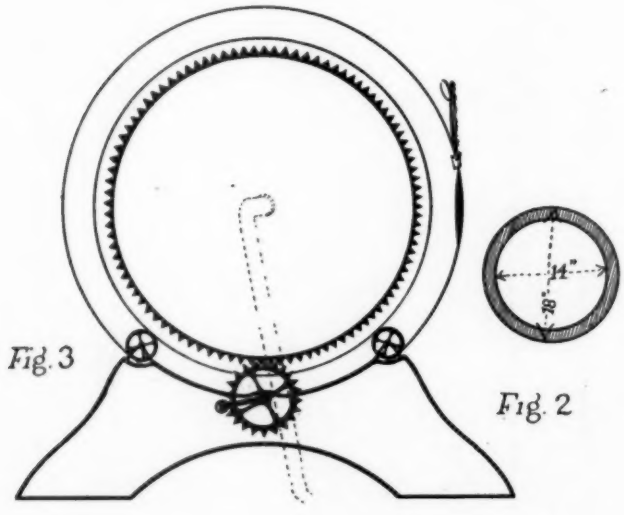


Fig. 3

Fig. 2

ring (Fig. 2) having an inside diameter of 14 inches, was forged out, turned true on one side and fitted in the opening the edges of which was ground free of all burned metal and chamfered to a 45-degree angle.

The entire furnace was then covered with asbestos paper, and the blast that is used for melting the aluminum turned on. Owing to the special lining in the furnace it was possible to bring the whole casting up to only a "black heat" even with the intense heat, which proved very satisfactory.

The lid 'C was taken off, chucked in a lathe and re-turned true. After the welding was finished, and lid put on, a distortion of 1/16 inch was found to have occured in the ring in welding. This was promptly taken care of with a hand grinder, and the furnace was again in service.

Fig. 1. Represents barrel-shaped steel drum used as a blast furnace for melting pig aluminum. It is heated by a blast of air and gas, admitted through suitable pipes at both ends. Has a special lining, and is held in its supporting frame on rollers, to permit the reception and discharge of the metal through door 'a.

'a Original size of door which was 14 inches.

'b Shows how opening was burned away by the blast escaping under door. This burned edge was unprotected by the lining.

'c Hinged door protected by lining on inside.

'd Five-inch pipes carrying air and gas blast to interior of furnace.

'e Supporting framework.

Fig. 2. Shows steel ring with an inside diameter of 14 inches (original size of opening), and measuring 18 inches outside.

This ring was forged, turned true and inserted in the opening and welded, bringing the size of the opening back to the original size of 14 inches.

Fig. 3. End view showing supporting rollers and turning gears.

Weight of the drum exclusive of framework, about 1¾ tons. Thickness of walls 1½in ches.

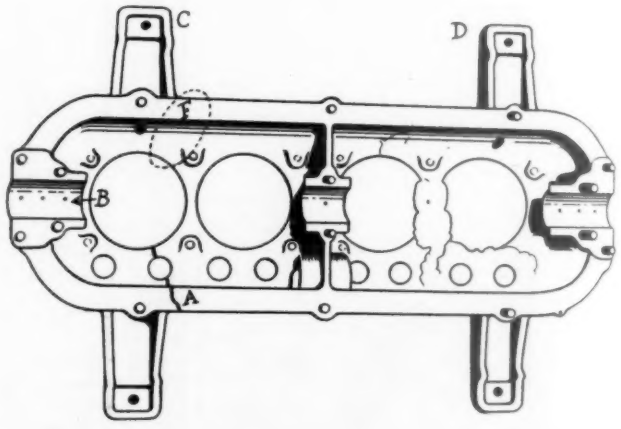
Line 'b in Fig. 1 should be shown rough and uneven burned portion.

G. F. KING.

Sidney Welding Works, Sidney, O.

Editor: I have figured out a little stunt which often helps me straighten an aluminum crank case, and which may be of use to others.

Suppose the crank case was broken at A and after all the usual precautions were taken and the weld finished, the bearing B was pulled a little toward the side where the weld was made (which is what usually happens). Instead of trying to stretch the weld (as I have done and as I have seen others try to do), place a long carpenter's clamp on arms C and D while the case is cold and heat at F with the



welding flame, until bearing B comes in line with the others. This shortens the length over all, but this is not serious. This method can also be used if the case is out of alignment the other way. That is, by shrinking the long parts instead of trying to stretch the short ones. I would advise, though, that none but experience hands use this unless it's on a case on which they are experimenting.

A READER (a).

Editor:

Enclosed find sketch of a 300 lb. cylinder of gas engine which I mended and made a perfect job. This break was 8 by 11 inches and the pieces lost, so I trued the edges and fitted a plate with sides 2 in. wide to the break with center cut out. After preheating, welded this ring to edges and let cool, then without preheating welded center in. This

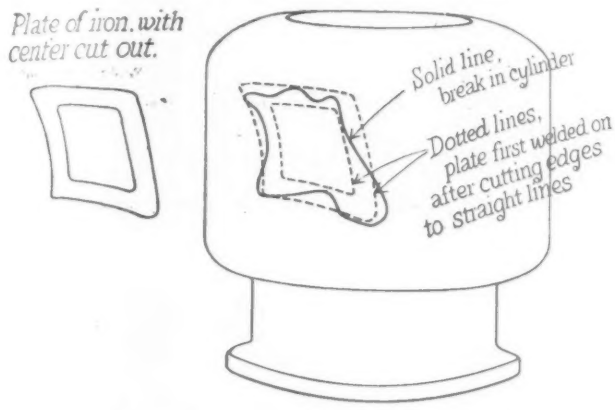


Plate of iron with center cut out.
Solid line, break in cylinder
Dotted lines, plate first welded on after cutting edges to straight lines

plate was $\frac{3}{16}$ in. thick, of good sheet iron. The first piece in cooling gave to the contraction of cylinder without breaking, and the last piece was easy to weld in. This job was done 16 months ago and there has never been the least sign of its not being O. K. I have since put on several patches this way and never had a failure.

SYD G. LOKEY.

Editor: One page 30 of your issue for April, 1916, one of your readers has a letter on the welding of scrap nickel anodes. He refers to an article on this subject which appeared in a trade journal last summer. For your information we are enclosing a copy of the article in question:

Your correspondent states that the article asserted that this work could be done at a price of 6 cents per foot. I presume that he intended to say 6 cents per pound. By referring to the reprint enclosed you will note that the statement is made that the work is being done at a total cost *for gas and labor* of less than 6 cents per pound, and does not claim that this amount includes overhead or profit. Since the latter two items vary with different shops, all estimates of this kind are of necessity made on the material and labor basis. Your correspondent intimates that in order to make a profit and cover overhead expense it would be necessary to charge 12 to 15 cents per pound, if the work were being done in an ordinary job welding shop. This may be true, but it does not controvert the statement that the work can be done for less than 6 cents per pound on a material and labor basis. The method he described in *The Welding Engineer* is undoubtedly much more expensive, since practically all of the scraps are wholly melted, whereas by the method described in the reprint enclosed the scraps are merely welded together.

The reprint also specifically states that the anodes in question are "castings containing 90 per cent nickel, 8 per cent carbon and 2 per cent iron. They are elliptical bars, approximately 1½ inches by 3½ inches cross section and 30 inches long, and weigh about 30 pounds." The costs given are naturally based on this particular alloy and this particular size. If scraps of smaller anodes are to be welded, the cost will probably be higher. If the anodes are only 80 per cent nickel, difficulties may be encountered. The writer recalls one bunch of small scraps that we attempted to weld which gave considerable trouble. Investigation showed that it was 80 per cent nickel—even though the owners had purchased it on a 90 per cent basis and were sure that it contained 90 per cent to 92 per cent nickel.

Pure nickel anodes are not suitable for use with the plating solution ordinarily employed, since the metal in the anodes is not dissolved or taken up by the solution rapidly enough as the plating proceeds. It is for this reason that an alloy containing about 8 per cent carbon is used. If a considerable portion of the alloy is remelted—as described in Mr. Baron's letter—then much of it will be rendered unfit for use, as most of the carbon is burned out and the resulting metal is very nearly pure nickel. By the method described in the enclosed reprint, however, only a very small part of this metal is remelted as the scraps are *welded*, not *recast*.

Your subscriber also makes the statement that the plating solution works on all surfaces of the anodes at the same time, and if they vary in thickness they will "wear out at the thin spots first and all your work will have very little results." This is incorrect. The solution begins its work at the bottom of the anode, if the anode is of the proper length, and attacks that portion more rapidly than it does at the top. The result is that when the anode is finally scrapped it has somewhat the formation shown in the scrap pictured in the enclosed reprint. In fact, even though the welded portion of the anode is much thinner than other portions, the solution will dissolve the bottom first and will probably not attack the welded portion to any extent at all, since this part has been melted and reduced to practically pure nickel.

Some of the anodes welded in our shop, pictured in the enclosed reprint, have been in service since February 25, 1915. They have given and are giving excellent service. In every case it has been found that the action of the solution began at the bottom end of the scraps that had been welded and that these scraps were entirely taken up by the solution before the welded portion was dissolved to any degree at all. Where small pieces of the anodes drop off into the solution—whether the anode is a new one or a collection of welded scraps—a chemical anaylsis will show that these samples are a porous shell of carbon containing practically no metal. This would seem to contradict Mr. Baron's statement quoted above.

I believe there is no doubt that your subscriber has gone to considerable unnecessary trouble and expense and that if he found it impossible to weld scrap nickel anodes in the manner described in the enclosed reprint for a material and labor cost of approximately 6 cents per pound, then his difficulty is certainly due to some cause not explained in his letter.

Yours very truly,
A. F. BRUMAN.

519 Sutherland Ave., Indianapolis, Ind.

The Chicago Machinery Club held its first regular monthly meeting at the Hotel Morrison May 1. Officers elected for the year were: President, C. W. Blakeslee, Abrasive Materials Company; first vice-president, E. P. Welles, C. H. Besly Company; second vice-president, H. A. Stocker, H. A. Stocker Machinery Company; third vice-president, E. L. Essley, Essley Machinery Company; treasurer, A. L. Beardsley, Cleveland Automatic Machine Company; secretary, D. F. Noble. Harry A. Wheeler, ex-president of the Association of Commerce of the United States, spoke on "Business Organization."

We are hearing considerable about the need of a national organization of welders. No doubt this would be a move in the right direction if the association was properly organized and managed. We would like to hear from the trade on this subject.

AN IMPROVED METHOD OF MAKING WAX PATTERNS FOR WELDING TEETH IN LARGE PINIONS

By F. N. Keithley

The proper shaping of the wax pattern for welding teeth in pinions by the Thermit Process is one of the most important operations in the whole repair, if not the most important. The new tooth must mesh properly or the entire repair will have been made in vain. This meshing is dependent on the wax pattern, its proper placement and form.

Up to the present time the usual procedure has been to construct a rough wooden box a little larger than the tooth

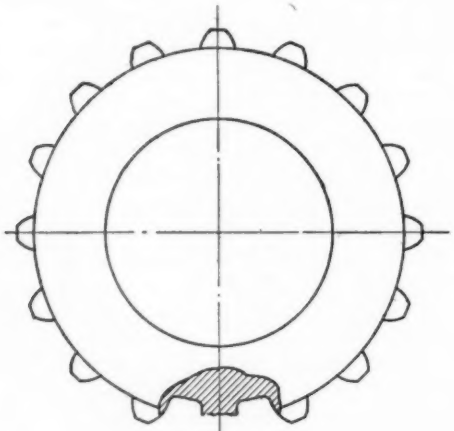


FIG. 1.

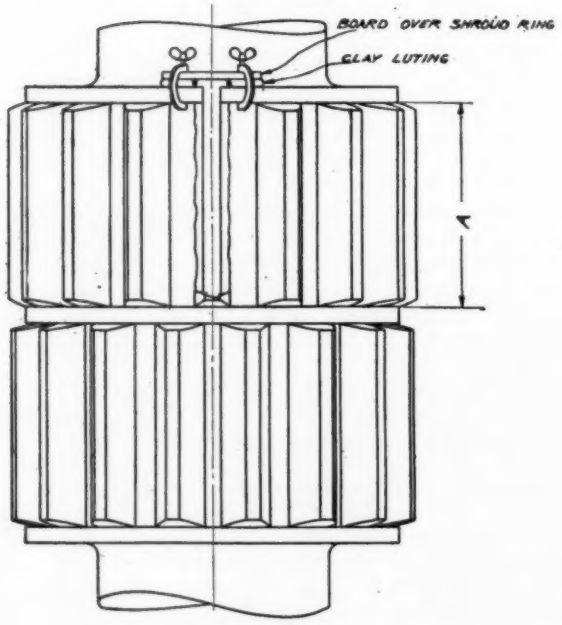


FIG. 2

Fig. 1—Section through broken tooth showing usual line of fracture.

Fig. 2—Showing method of cutting shroud and attaching board and clay luting for welding shroud.

to be welded in and place this against the pinion where the new tooth is to be added, luting around the edges with fire-clay. This box was then completely filled with molten wax, and when the wax had set, the box was removed and the wax pattern brought to proper form by means of a template. This template was usually made from ⅛-inch steel plate, and the outline of three teeth cut into it by using three good teeth in the pinion as a guide. The center tooth, however, which represents the guide for the tooth to be welded in is cut 1/32 inch larger all around so as to allow for the contraction of the Thermit steel tooth.

The two outside teeth of the template can then be engaged with the teeth on each side of the wax pattern, and when the template is moved up and down it will cut the wax to proper shape and assure that the new tooth will be welded on in proper pitch.

This method has proved very satisfactory in practice, but is open to the objection that if the teeth of the pinion are worn irregularly the template method does not take care of these irregularities so that the new tooth will be of exact shape of the worn teeth. For instance, the template represents the shape of the adjacent teeth at one point only, while perhaps at some other point there may be greater wear.

It was to improve this condition and at the same time

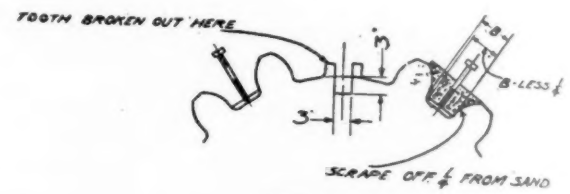


FIG. 3

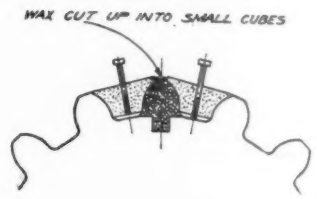


FIG. 4

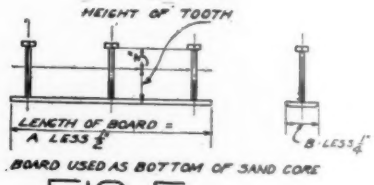


FIG. 5

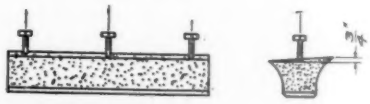


FIG. 6

Fig. 3—Sand core rammed to form mold for one half of tooth.

Fig. 4—Both cores in position and filled with wax.

Fig. 5—Design for board to support bottom of sand cores.

Fig. 6—Section and elevation of sand cores used as one-half of wax pattern mold.

devise a method which would save considerable time in the making of these repairs that I developed the following method. Briefly, the new method consists in making a sand mold for casting the wax pattern, using the adjacent good teeth in the pinion as models to go by.

It has been my good fortune to have the direction of a great many repairs of this character, and the method which I have described has been thoroughly tested and found satisfactory in every way.

Referring to the accompanying illustration, the patterns shown in Fig. 3 should be made and fitted as indicated, after which sand should be properly mixed for cores, using two parts of building sand to one of fireclay, and this should be sifted through a No. 4 mesh riddle and should then be mois-

tened a little more than would be necessary if it was to be used in ramming a mold. If this mixture does not draw well, more clay can be added, as the clay will not affect the wax in any way.

The pinion should then be placed in a horizontal and level position with the missing tooth section in the center of the upper part. The core can then be rammed after first thoroughly cleaning between the teeth which are to be used as the guides, and which should be nearest the top.

The pattern is then placed in the bottom of the space between two teeth and held with lag screws, after which the core is rammed firmly to a point ¾ inch above the height of the tooth, as indicated in the drawing. The most convenient way to do this is to use an iron or wooden strip ¾ inch high on the top of the tooth. The core should then be slipped from that height to the level of the opposite tooth. The idea of providing this extra height is to hold enough wax for shrinkage.

After the core is thoroughly rammed it should be carefully drawn by two men, using the end lag screws for the purpose. It should then be set carefully upon a box wide enough to support it over the entire length. It is advisable to force a little sand under it in order to keep the core stationary. Two cores are necessary in the making of one tooth and the other core is made in exactly the same way as the first. When these are ready the operator should start at one end of a core and remove ¼ inch from top to bottom over the entire surface, as shown in the drawing. After this has been done the surface should be slicked to make it smooth and marked so as to be sure of placing it in its proper position. It should be understood that this sand is removed from the side of the core which does not come in contact with the wax.

The object of this cutting is to make the mold slightly larger to take care of shrinkage of both wax and Thermit steel.

The cores can now be placed in position, one on each side of the missing tooth, making sure that the sides of the core from which the ¼ inch has been removed are resting tightly against the adjacent teeth. A weight should then be placed partly on adjacent teeth and partly on the core to hold it in correct position. The end can then be stopped off with fireclay mixed to the consistency of putty, after which the mold, i. e. the interior of core, can be filled with small pieces of wax about 1 inch square, after which melted wax can be poured in, thus filling up all spaces between the small pieces of wax.

Care should be taken not to have the wax too hot, as it is only necessary that it should be hot enough to run freely. If it is boiling hot it will tend to eat into the sand and make a rough tooth.

The mold should then not be disturbed until the wax has set, which will be from three to four hours after pouring. In the meantime, however, other work can be done, such as mixing sand for the mold, assembling mold box, etc.

If the pinion is shrouded, the wax pattern to provide the Thermit steel reinforcement on this shroud can be put on at the same time that the wax tooth is formed, it being only necessary to roll a long clay rod about 1 inch in diameter and lay it against the pinion 3 inches away all around from the space cut through the shroud, then back up with a board large enough to extend above the top of the tooth.

This board can be held in place with two "C" clamps, and luted with clay between board and cores on the inside so that the wax will flow to its proper level. (See Fig. 2, page 12.)

This work is all done in green sand, and if care is taken while making the pattern for the new tooth with this method, there will be very little finishing on the wax, thereby effecting a saving of about two days on each welded tooth, not to mention the added advantage that the new tooth will be welded on in proper pitch and will have the exact form of the other teeth in the pinion, thus eliminating any undue st.ins when the pinion is placed in service.—*Reactions.*

AN ASSOCIATION FOR THE WELDING INDUSTRY

It is about 15 yeais since I first became acquainted with acetylene welding, and since then I have devoted all my energies to its welfare.

At that time it was still a question whether the process would be of any benefit or not. Criticism and condemnation came from every direction. It became a hard task to the few championing firms to keep the process from falling into oblivion, and true to their principles they have undergone a large expense for its maintenance.

Today, no one will doubt the usefulness of the process, and that it has attained an important place among the trades in general. What it needs, at present, is an association, whose aim it should be to improve welding trade conditions and in which various welders from all over the country could participate.

There are at present fifteen welders in the small town where I am now residing, and all feel a certain desire to become a part of an association that would champion their trade.

I should think that by forming such an association, all the welders would realize that a great power has been created for the strengthening and uplifting of their business, and that it would become a matter of self interest for everyone to become an active and supporting member.

We all realize what progress the welding business has already made. Out of all the hindrances and uncertainties of its earlier days, it has emerged a trade worthy of pursuing. Almost every large corporation is employing a welding method today. It is true they meet with some failures, but the fault does not lie with the process. In most cases, illiterate and unintelligible men are turned into welders, thinking that skill is a matter of little importance when the proper apparatus is employed.

The future of the welding business depends largely upon the class of men interested in the work. In earlier days a welder would depend on his good fortune to make a successful weld, today, a good weld will be accomplished from a knowledge of the device and the technique of the metals. Only men with this latter knowledge should be entrusted with welding operations, and in that way insure success.

Moreover, the failures, heretofore experienced would be eliminated if the men who are welders today could in some way exchange their views with their fellow welders. This could be easily accomplished by forming an association, whose aim should be to conduct a campaign of education, discussions and analyses of new tendencies in the welding business, all recommendations made thereupon and to keep track of all progress made in the field.

There are such associations in Berlin, Paris and London, soundly established, and there is no reason why in such an industrial country as the United States there should not be a similar association, to raise the standard of dignity of the welding trade.

B. Kopperschmidt,
Jackson, Mich.

We have heard quite a little recently about the necessity for a school of welding. In fact, we have been urged to start such a school. The business of running a trade paper keeps us quite busy, but if we thoroughly believed in the merit of the enterprise we might undertake to open a school of welding. An undertaking of such a character would require considerable thought and study. No doubt a school would advance the art of welding and "we are for that." What do you think of it?

Trade News

OXY-THERMALENE WELDING

By Linus Wolf

Thermalene gas is a combination of calcium carbide and hydro-carbon oils. By the remarkable novelty of the Wolf process the heat generated from the carbide is actually used to vaporize the oil. In the process of generation this gas, phosphur and sulphur gas and other impurities which render high pressure gases explosive, are automatically removed through water and oil gas cooling in the generator. This mixture of acetylene and oil gas, called "Thermalene" gas, has more body, producing a softer, non-oxidizing flame. This assures a more uniform weld and a cleaner cut, without rendering the metal brittle. The generator produces gas only when in use and the water inflow is automatically controlled by a pressure gauge.

A great many experiments have been made by gas engineers and it has been found that all generators which are run by a water feed to the carbide do not run properly and are more dangerous than carbide in water. The process which uses heat from the carbide to vaporize the hydro-carbon oil is very valuable for practical use, either for cutting, brazing or welding.

At the present time the Thermalene Company manufacture four sizes of generators. These generators will produce from a No. 1 cartridge about 20 feet of gas, No. 2 about 50 feet, No. 3 about 75 feet and No. 4 about 150 feet of gas.

In large factories where there are from eight to twelve welders we can connect a number of generators with one feed pipe line. About five No. 4 generators, with one charging, will supply ten welders for about seven hours. The Thermalene generator is a long-life machine as there is no sulphur hydrogen or phosphor hydrogen present. By cooling the hydro-carbon oil gas by water, on top of same, some of this gas condenses to oil and is prevented from corroding in the generator.

Thermalene gas has been compressed to a pressure of 2,200 pounds by using a small high pressure compressor,

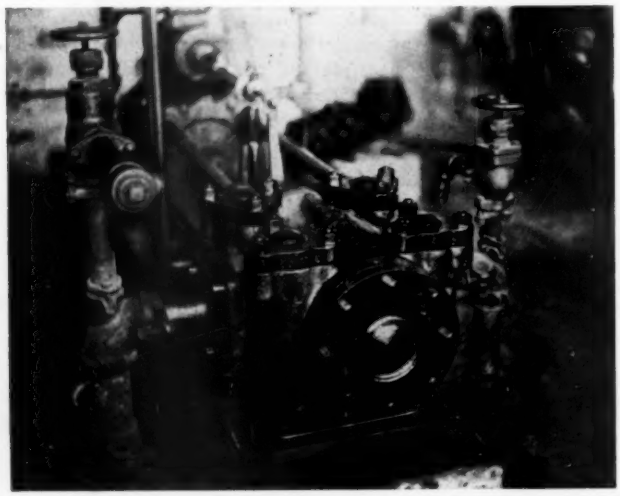


Fig. 1—Ammonia compressor after being welded with Thermalene.

Fig. 2—Cutting water pipes with roller cutter.

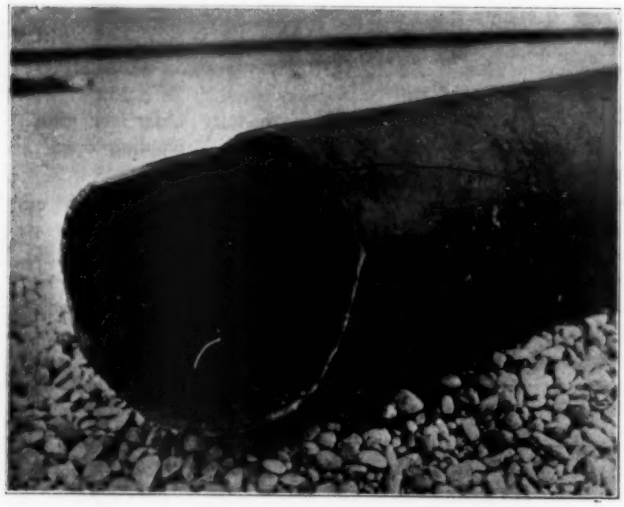


Fig. 3—What happens when roller cutter is used.

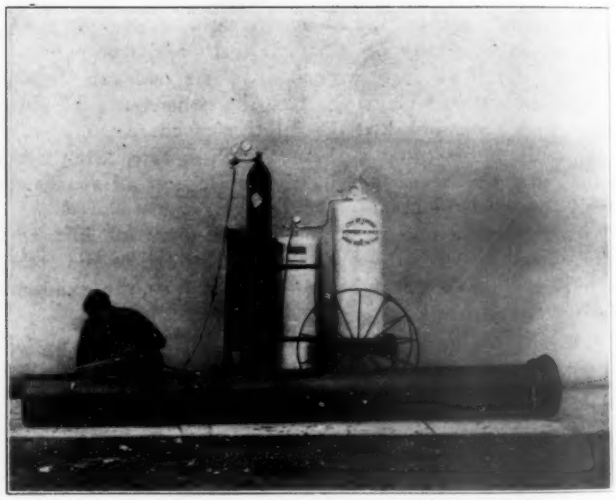


Fig. 4—The modern way of cutting.

connected with an extra heavy long pipe at the end, and connected with a high pressure gauge and safety valve. These experiments were also made by Mr. Nogles, at the laboratories of the National Board of Fire Underwriters. It is very easy to liquidify this gas mixture without any danger. It is known by all acetylene engineers that acetylene gas may explode when it exceeds 15 pounds pressure, but if the acetylene gas goes through a special cleaning and cooling process, by which the phosphur hydrogen is removed, there will be no danger in liquidifying it. This method was in practical use in France from 1904 to 1907, but because of uncareful cleaning and washing there were several accidents and the method was abandoned.

Acetylene oil gas is a very well known gas and is in practical use under the name of "Pinsch" gas, by railroad companies, who use it to light their passenger cars, under a pressure of 220 pounds.

A test made by Prof. MacCormack, of the Armour Institute of Technology, with Thermalene Generator No. 1, which uses the smallest amount of heat and vaporizes the smallest amount of oil, is here shown. In another test in our own factory, with generator No. 3, we found that 13 cubic feet of our gas weighs one pound. Thus you will see that Thermalene is heavier than any other gas, and can be used in a mixture with less oxygen, which assures a better mixture and produces a more uniform weld and a non-oxidizing flame. It also makes it very easy for non-competent welders to operate the welding tool.

Thermalene gas is being applied to large steel companies for special purposes, such as welding high and low carbon steel, wherein other gases have failed. This gas, in the welding of cast iron, produces a soft surface which is very easily machined. Thermalene gas is the only gas which can cut water pipes, as these pipes are not of even thickness of material and when cut by a roll cutter cracks as is shown in picture No. 2. Picture No. 1 shows the cutting being done the old way. Photograph No. 3, which is taken of an outfit which is being very successfully used by the City of Chicago, shows the new way of cutting by the Oxy-Thermalene method. This pipe was ⅝ of an inch thick. The reason that Thermalene gas is able to do this work is due to its non-oxidizing flame. Acetylene oxygen would form on top of the metal an oxidizing skin which prevents the head from going through the metal. The fourth picture shows a pulley which is being prepared for welding, without pre-heating. This welding can be done only with a non-oxidizing flame. Picture No. 5 shows pulleys welded without pre-heating.

Fig. 5—Thermalene outfit for city of Chicago.

Fig. 6—Another view of same outfit.

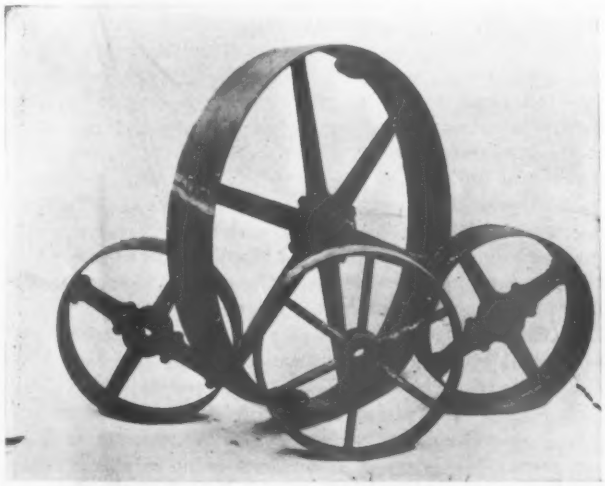


Fig. 7—Pulley wheels welded with Thermalene and without preheating.
See Fig. 9, page 36.

Fig. 8—Factory of Thermalene Co., at Chicago Heights, Ill.

SPOT WELDING LIMED AND RUSTED MATERIAL

It often happens that it is necessary to spot weld limed stock but owing to the insulating properties of the lime it is difficult to get the current to pass through the material.

Cleaning by hand is expensive and the shape of the work often makes the emery wheel impossible. Vari-

ous acids have been proposed for the purpose but these cause the material to rust and produce defects in any painted finish which is subsequently applied.

For some time past the steel automobile body builders have been using a chemical known as "Deoxidine" for cleaning their products before painting so that they will not rust under the paint and it has been found that it works like a charm for dissolving the lime which causes trouble in spot welding.

Immediately before welding the Deoxidine is applied locally with a brush and the work welded before the Deoxidine has had a chance to dry. After welding any excess Deoxidine is removed by wiping with a rag.

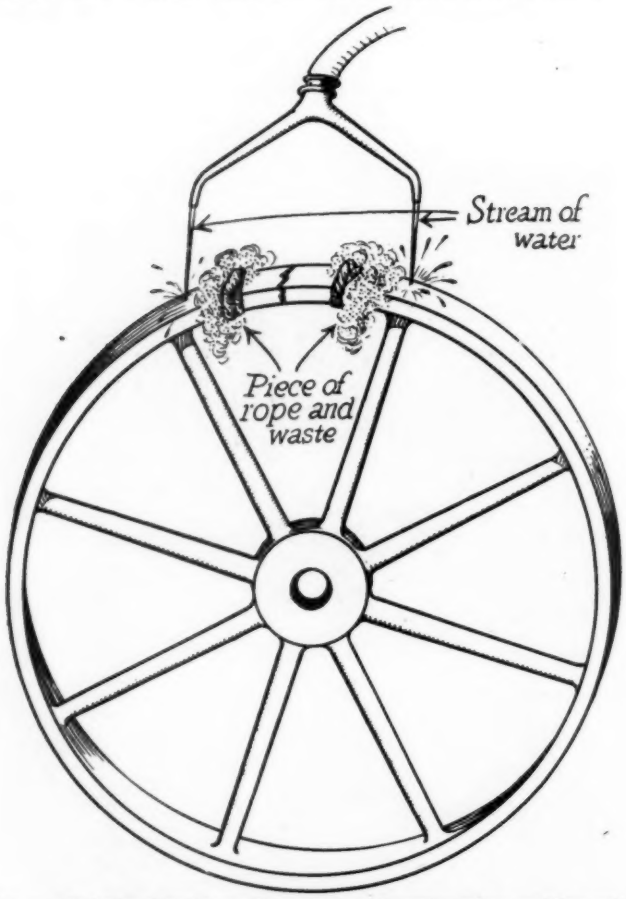


Fig. 9—Method of cooling pulley wheel with water when welding with Thermalene.

The welding of rusted material is greatly improved by the use of Deoxidine. A thin coating of rust is dissolved in a few moments but a heavy coat of rust requires some rubbing with emery cloth in addition to the Deoxidine.

Deoxidine acts like an acid but has none of the rusting properties of an acid, in fact it prevents rusting. Although not explosive like gasoline yet it can be lighted with a match and so any vessel holding the Deoxidine must not be placed where the sparks from the welding machine can fall into it.

"HOOVER" COMBINATION WELDING AND CUTTING TORCH

The Oxy-Acetylene Products Co., Chicago, Ill., Manufacturers of Oxy-Acetylene Welding Apparatus, have recently perfected a torch for welding and cutting of all metals. The new torch was designed by Mr. Harry B. Hoover, formerly connected with the Turner Brass Works, Sycamore, Ill. Mr. Hoover is very well known in the trade as a designer of torches and as a practical welder.

With the Hoover torch it is possible to do any class of welding from the largest to the smallest jobs. The one torch can be adjusted to many different sizes and shapes, or in other words, the operator may adjust the torch to meet conditions. It is easily changed from a welding torch to a cutting torch.

The head is cast en bloc, and requires no tips, which makes it a positive leak-proof head. In old style heads where tips are used the joints frequently become bad, causing a leakage inside or outside. A leak inside would allow high pressure oxygen to crowd through into the mixed gases, causing the torch to pop or flash back. A leak on the outside would allow the gases to ignite and burn at the leaking point, causing the torch to become over-heated, causing it to work improperly. It would also cause a waste of gas.

The cutting head is adjustable to two different positions one being a regular right angle torch and the other a straight ahead cutting torch. These adjustable features allow this torch to do work requiring five different styles (or separate) torches to accomplish.

Different sized heads are used instead of tips where different thicknesses of metals are cut.

The construction and design of this torch makes a more simple, stronger and durable torch with more efficiency, and a wider range of work than any other torch.

This head can be used on a medium or high pressure system.

DAVIS-BOURNONVILLE CHANGES

Davis-Bournonville Company announces a change in their selling arrangements in New England. Under date of April 10th the following circular was issued to the trade:

"For many years Davis-Bournonville apparatus has been introduced to the metal working industry in New England by the Cave Welding & Manufacturing Company, as general dealers. Mr. Henry Cave, president of the company, has been continuously and prominently indentified with the oxy-acetylene industry since its introduction in the United States. He has been a liberal contributor to the technical and trade press, has been invited to lecture on the oxy-acetylene process and its applications, before technical and educational associations, and his extensive technical and practical experience has given him an authoritative position in the industry.

"The Davis-Bournonville Company realizes the value to the whole oxy-acetylene industry of extended research work in the continued development and application of the process. With the intent to provide, as in the past, the most conclusive data available for service to its customers, and with the belief that Mr. Cave can be of even greater service through such work, in an industry to which he has devoted so much effort, this company is pleased to announce that he has consented to take active charge of its research department, at the general offices in Jersey City, N. J. He will, however, retain his interest in, and act in an advisory capacity to the Cave Welding & Manufacturing Company.

"To enable Mr. Cave to do this, the Davis-Bournonville Company has arranged to take over the sale of its apparatus in the New England states at once, extending directly to that territory the co-operative service, from manufacturer to customer direct, that the company's experience and development work in association with hundreds of prominent concerns throughout the country employing its apparatus, permits.

"A sales office will be established in Boston shortly, and in other New England cities, for the greater convenience of customers. The Cave Welding & Manufacturing Company will continue to assist the users of Davis-Bournonville apparatus to the best of its ability, whenever opportunity offers, co-operating with the company's sales engineers and service department."

SHEBOYGAN COMPANY GROWING

A recent issue of a Sheboygan (Wis.) newspaper has the following to say about the Universal Oxygen Company, a well known company in the welding trade:

"The Universal Oxygen Company was incorporated under the laws of Wisconsin in the year 1913. It is located at the corner of Fourteenth Street and Illinois Avenue, and a branch has been opened in Milwaukee. Its present officers and directors are as follows: President, E. M. Parmelee; vice-president, H. J. Mueller; secretary and treasurer, D. D. Rowlands, and W. B. Lucas, director.

Its general manager, H. J. Mueller, vice-president, has had a wide range of experience in this line of work, having been connected previously with the largest concerns of this kind, both in Europe and America. He supervised the erection of the first concern of this kind in the United States, which was built at Milwaukee, Wis., in the year 1908.

"In the year 1913 he became interested and connected with the Universal Oxygen Company, of Sheboygan. He here also supervised the erection of their plant, installing electrolytic cells for the manufacture of oxygen and hydrogen of his own design and invention. These cells are capable of producing the very highest grade of gases, oxygen 99.6 per cent and better, and hydrogen 100 per cent.

"The two gases are manufactured from distilled water, and separated by an electric current into H_2O, two parts hydrogen and one part oxygen and the design and construction of the cells is of the greatest importance as the purity of the gases depends largely upon this construction.

"The plant is operated 24 hours a day, seven days a week, 365 days a year, and produces a total of 2,628,000 cubic feet of oxygen per year, and 5,256,000 cubic feet of hydrogen. It is run by a 100-kilo-watt motor generator set of the most improved, which obtains its necessary power from the plant of the Sheboygan Railway & Electric Co. Twelve men are employed to operate the plant, which is run in shifts.

"After the gases have been manufactured and purified, they are compressed in steel cylinders under 2,000 pounds pressure, and are then ready for shipment to consumers. It has been found necessary during the past year, due to the great demand, to increase the plant to double its past capacity, and the company has sufficient property to permit additional enlargement."

GOLDSCHMIDT EXPANDING

We feel sure that many of our readers will be interested in knowing that the Goldschmidt Thermit Company have now completed arrangements enabling them to add electric furnace 50 per cent ferrosilicon to the extensive line of metals and alloys which they supply. They have been appointed exclusive representatives and sales agents for the Keokuk Electro-Metals Company at Keokuk, Iowa. This concern expects to have in operation by April a new electric furnace plant located at Keokuk and they will, therefore, be in an exceptionally strong position to supply the large steel plants in the Middle West. Their production for the present will be about 2,000 to 3,000 tons yearly of 50 per cent ferrosilicon, which should be of particular interest to manufacturers of basic steel.

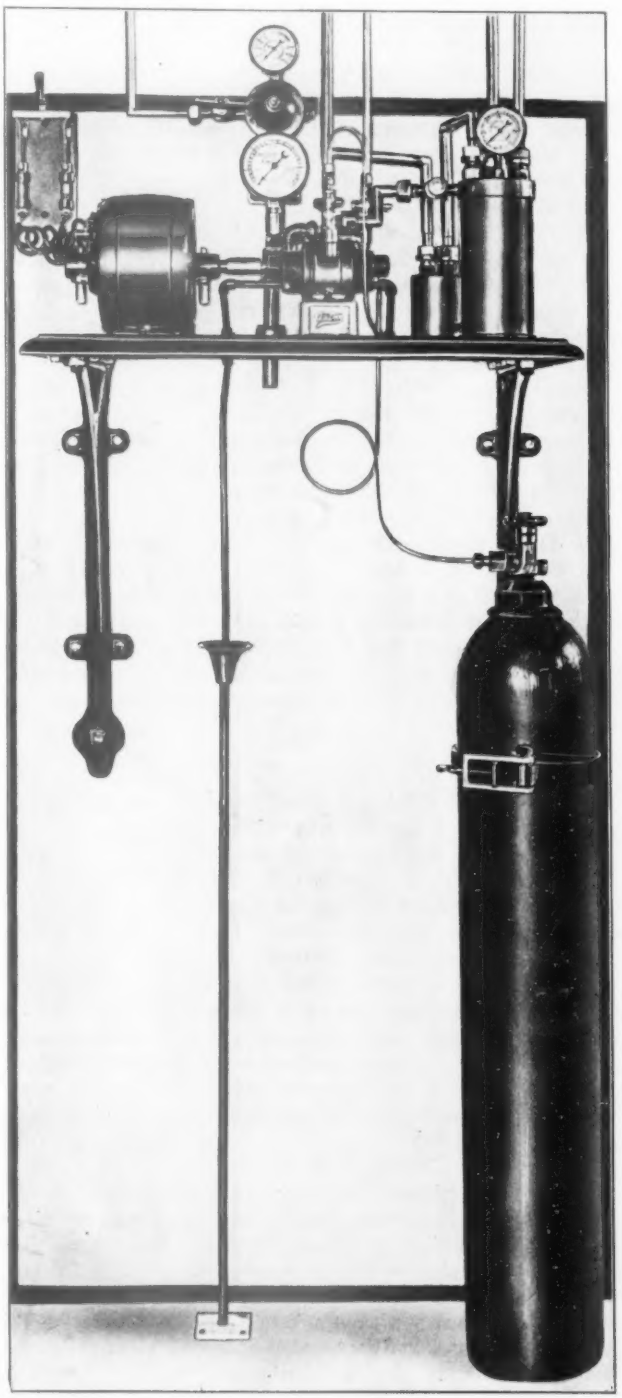
The officers of the Keokuk Electro-Metals Company are also officers of the Otis Elevator Co.

At the present time 50 per cent ferrosilicon is produced by one large company in the United States, as well as by several concerns in Canada. Before the war the alloy was imported from abroad on quite a large scale, principally from the Scandinavian sources, but this business has, of course, been practically discontinued on account of the difficult shipping situation. While steel makers may use high silicon pig iron, by far the largest tonnage of the silicon is consumed in the form of the 50 per cent alloy, as this is extremely soluble and does not tend to disintegrate in transit.

On account of the present scarcity of the alloy and the high price we feel sure it will be welcome news to steel manufacturers that a new and promising company has entered this field. As the Goldschmidt Thermit Company are the exclusive selling representatives all letters and inquiries should be addressed direct to their New York office.

SPECIAL MACHINE FOR WOODS CO.

The accompanying illustration shows an "Astra" Illuminating Gas-Oxygen Motor Pressure Set (heavy duty style, water jacketed). This machine was invented and designed by Mr. E. Raven Rosen-Baum, a consulting engineer, high temperature gases, New York City. The machine was in-



stalled at the plant of the Woods Motor Vehicle Co., Chicago, and was manufactured by Ashton, Laird & Co., of New York. A description of the aluminum body welding which is being done in the plant of the Woods Company, was printed in a recent issue.

The 20th annual meeting of the National Fire Protection Association was held in Chicago, May 9th, to 11th inclusive. A subject discussed of interest to the welding trade was the report of the committee on proposed revised regulations for the installation and operation of acetylene generators, the use of acetylene for lighting, and the storage of calcium carbide.

Mr. A. Cressy Morrison, secretary of the Acetylene Association was in attendance, as well as engineering representatives of several manufacturers of acetylene.

Campbell & Rickel, of Minneapolis, who have been handling the Torit welding apparatus in the past, have incorporated under the name of United States Welding Company, with a capital of $50,000 and are now manufacturing their own "U. S." oxy-acetylene welding, cutting, carbonizing-burning apparatus and parts.

The new "U. S." welding and cutting torches are the results of much labor on the part of their engineering department and show many improvements which have caused considerable interest in the welding world, as they are marked by simplicity, yet absolute efficiency in design as well as structure.

The catalogues of the newly incorporated company contain many new ideas and should prove of great interest to all those in the oxy-acetylene welding and cutting business.

The main offices and salerooms continue to be at 234-6 Hennepin avenue, Minneapolis, Minn.

The Superior Oxy-Acetylene Machine Company of Hamilton, Ohio, have designed a welding torch which is especially adapted for heavy welding work, being made in lengths from 24 inches to 3 feet. The main feature of this torch is that it will not only do heavy welding work, but light or ordinary work as well, using tips from No. 1 to No. 10. This torch is very substantially constructed and heavily nickel plated.

The main office of the Goldschmidt Thermit Co. has been moved from 90 West Street, New York City, to 129 Broadway, which is the Equitable Building.

The Gibson Co., Indianapolis, Ind., in their 1916 catalog describe their welding and cutting, decarbonizing and hydrogen lead burning apparatus—also show a line of welded high pressure air storage tanks.

A new pressure regulator for welding apparatus has been patented by Patrick M. Grant and will be marketed by F. C. Kuhnle & Co., Chicago. A feature of the new regulator is the adjustable parts which enables the user to make necessary adjustments which usually mean a trip to the factory.

A pamphlet entitled "The Technical Production of Hydrogen and Its Industrial Application" has been published by Harry L. Barnitz, 617 West 152nd St., New York City.

Several contracts covering welded lines and other necessary work have been accomplished at the hands of the Hope Engineering & Supply Company, of Mount Vernon, Ohio, having office also in Pittsburgh.

A big compressor equipment contract is held by the company. This apparatus goes in at Big Heart, Okla. We understand that the company is putting in welded lines for both high pressure artificial gas, and for natural gas.

QUESTIONS AND ANSWERS

Editor:

Will you please tell us through the "Question and Answer" columns, the relative qualities of oxygen gas made by the electrolytic process and that made by atmospheric process, also give the relative qualities for cutting of steel and welding work?

J. B. KIRK.

Answer: If the oxygen made by each of the processes you mention is "pure" (100% oxygen) the results will be the same for both cutting and welding. The processes of manufacture do not govern the relative efficiency of the gases—it is the care taken by the manufacturers to purify the oxygen that will goven your results. In the Liquefaction process nitrogen is the impurity; in the Electrolytic process hydrogen is the impurity. The integrity of the manufacturer is the governing feature. It is our opinion such manufacturers of oxygen as are advertisers in this medium may be relied upon to furnish oxygen of the best grade.—Editor.

Editor:

In your April issue I note that F. J. Maurer, Supt. Davis-Bournonville Shops, states that in welding cracked automobile cylinders it is not necessary to heat same more than about 500 degrees or just hot enough that you cannot lay your hand on it. I fail to agree with this statement altogether. In order to weld the crack you must heat that part to about 2,200 degrees and the rest of the cylinder only heated to about 500 degrees. Why wouldn't there be an uneven expanding and contracting? I would be pleased to see other opinions in regard to this in your next issue, especially the Editor. J. A. ROBERTS.

Eddyville, Ia.

Editor:

Concerning welding an ordinary wash pot. It has been cracked almost to the center. I am not fixed to preheat only by means of an oven that we heat wagon tires in. I have tried this job and when it was almost completed it cracked again. Please give me your advice.

Yoakum, Texas. CHARLES E. EDINBURGH.

Answer: Place the pot in your preheating oven in a position it would occupy when in use, when the pot has become thoroughly preheated turn it up on the side with the crack on the fire and then weld from the inside. If you do this we do not think you will have any further trouble.

We are assuming that you have been preheating on the side opposite the crack. This, of course, expands the metal and closes the crack and when the pot cools the crack opens and there is a strain on the weld. If you preheat as we have stated, the crack will immediately expand and when cooling will contract.—Editor.

Editor:

Should a cast gear wheel, say 30 inches in diameter, be preheated all over to weld in one tooth, or just preheated where the tooth is out?

Sullivan, Ill. HERMAN LAMBRECHT.

Answer: It will not be necessary for you to preheat a cast iron gear wheel in order to weld in one tooth or in fact to weld any number of teeth. You would effect a considerable saving in gas, however, if you did preheat directly at the point where the tooth is to be welded in. This is not necessary, however, on account of contraction or expansion.—Editor.

Editor: I use the same outfit on the road as I use in our shops. My outfit works all right on the road, but in the shops, when using gas from generator, my torch pops out. I have changed tips, changed the supply of oxygen and acetylene, but can't find the trouble.

Detroit, Mich. A. C. SMITH.

Answer: If you are using the same oxygen in shops as when working outside we should say your trouble is due to impure or improperly dried acetylene. Perhaps the generator is not being cared for properly.—Editor.

Editor: In welding malleable iron a chemical change takes place at or about 1000 F. Your weld may look good while fire is still on it, but when taken off fire work which looks solid is porous. In welding malleable parts commonly found on automobiles, such as housings, lever brackets, etc., I find that by chamfering broken parts just about through from one side and using manganese bronze filler rod, and not allowing malleable to get to a running heat, I am very successful.

THOMAS (A).

I have never been able to weld copper to nickel, nor have I found any one who can successfully do this work. Can you tell me how to proceed?

A. H.

Answer: We are unable to give you in this issue a satisfactory answer. Watch this space next month. We may have an answer for you.—Editor.

WELDING LOCOMOTIVE CYLINDER AT ENGINE

By B. Kopferschmidt

The cylinder is that part of an engine in which the steam is utilized upon the piston; it is made of cast iron and is perfectly bored.

In working with cylinders, one must be very careful, for the least uneveness will prevent the cylinder from performing its functions. Steam leaking between piston and cylinder, the piston working hard, or sometimes sticking fast; failings such as these will result from uneven cylinders.

It, therefore, becomes a task to a welder in working with a cylinder to see that his preheating and cooling is gradually accomplished. Should the cylinder be somewhat warped it can be rebored, but this operation can be saved in many instances if the operator is careful and uses proper judgment during the entire operation.

Locomotive cylinders frequently have cracks, due to freezing, shocks, internal strains and wrecks. These cracks will vary in position, and it is with regard to the position of the crack that the difficulty of the weld is measured. Little difficulty confronts the welder when the crack is in a horizontal position on the cylinder, but when the crack happens to be on the side of the cylinder or on the flange or port holes, or overhead at the upper wall of the cylinder, then more difficulty in handling the job is experienced.

Method of Welding Horizontal Cracks

To weld the crack when it is horizontal, it must first be bevelled to a 45 degree angle and then have a preheating furnace built around it. Before proceeding to build the furnace, however the port holes must be closed tight, with fire clay or block asbestos, so the heat should not be lost in the valves.

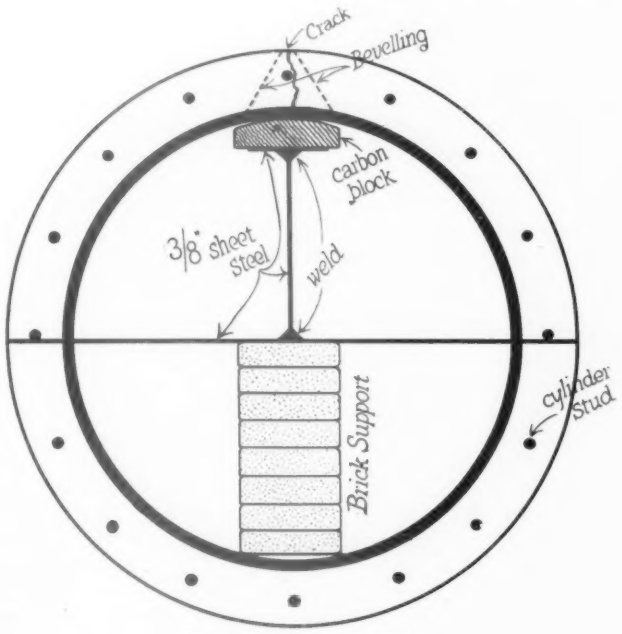
To build the furnace, place two or four wooden blocks directly underneath the cylinder, the number of blocks, depending on the distance of the cylinder to the ground. Cover these with ⅜ inch or ¼ inch sheet steel big enough to form an ample platform for the furnace. On this plate come two rows of bricks covered with fire clay. Then build brick walls all around the cylinder, leaving eight inches or more, if possible for fuel displacement. The first row of bricks should be set leaving one inch distance between the bricks for draft purposes, the bricks in the following rows maybe placed close together and across each other. At the defected end a space about twenty-five square inches is left so that the operator may be able to perform his work.

At the upper line of this opening a sheet of ¼ inch plate, the width of the brick and the length of the wall furnace, is placed to form the support for the upper wall of bricks. The height of the furnace above the flange should not extend more then three inches.

Then the furnace is filled completely with fuel, 80% charcoal and 20% coke, either through the top opening or through the square hole at the end. With the use of a welding blowpipe the fuel is kindled through each of the bottom spaces between the bricks. After waiting thirty minutes for the fire to start well, both openings should be closed with sheet asbestos. Then it is necessary to wait four hours, when at the end of that time the furnace is refed, this time charcoal alone being used.

After waiting three more hours, the cylinder will be cherry red and ready for welding. Care must be taken to see that the flange at the defected end is cherry red *all around* before attempting to weld the crack. As to the other end of the cylinder it may not necessarily be red.

Then cover the bottom with asbestos sheet ¼ inch leaving only the beveled crack uncovered. This is to protect the operator's hands, as well as to keep the blowpipe from being overheated. Also it is necessary for the operator to have two pairs of asbestos flannel lined gloves, so that when one pair becomes



Welding locomotive cylinder.

hot he may change to the other. The gloves must never be dipped in cold water as it will form steam.

Whenever the crack is longer than six inches a long handled blowpipe can be used, and should be cooled every five or ten minutes by dipping into cold water. Also a piece of ⅛ inch sheet steel thirty inches square lined with ¼ inch sheet asbestos may be placed between the furnace and operator to protect him from the heat.

The welding operation can then be undertaken and it should be started from the end, care being taken that enough material be left at the surface of flange that it may make a bearing for the cylinder head. A skillful welder will make his weld so that the cylinder will not require boring when finished, by not overcharging the weld too much and yet not leaving any holes below the line of the cylinder. All that would be necessary in that case would be to file off with a half round file at the welding line.

At the end of the welding operation, if the cylinder flange at the repaired end is not cherry red *all around*, more charcoal should be added until a uniform cherry red is obtained.

Then the draft holes are closed with fire clay and the square

opening with fire bricks and fire clay. The asbestos on top is weighed down with a row of bricks, and every possible precaution should be taken that no draft holes or crevices be left open. Let it stand in that position for 36 hours after which time the furnace may be removed and the welding job is finished.

Method of Welding Cracks on Side of Cylinder

Should the crack happen to be on the side of the cylinder, the preheating and cooling process would be the same as above, but the welding would become more difficult; and only experienced operators should undertake this job. In proceeding with this kind of a weld one should start from the bottom line of the bevelled crack and build up the weld to the top without too much flowing on the outer side, and to see that the joining of the metal is perfect. To finish up this weld it is necessary to use the boring machine.

Method of Welding Cracks at Flange or Port Holes

In case the crack be at the flange or port holes the same preheating and cooling instructions should be followed, with the exception that the square opening should be raised higher so that the defected part should be about the center of the opening. If the broken piece is less then five inches long then a new piece should be built in, discarding the old piece. Care must be taken in this weld that the metal shall join with the brace between cylinder and flange. A good method in building up new pieces in the flange is to place a ⅜ inch steel plate three inches wide between two studs on the flange about three or four inches below the broken piece. On top of this sheet place bricks or carbonized blocks (carbonized blocks preferred), the top surface of which should be ground to conform with the shape of the cylinder. These blocks should be placed under the flange to cover the port holes and should extend outside of the flange sufficient for building up a bearing.

After the building up of the metal is finished remove the blocks or bricks and steel plate from under the weld and with the aid of the blowpipe melt off the surplus metal from the top, side and bottom, taking care that enough metal is left on the side of the flange for securing a continuous joint. In order to facilitate faster work carbon blocks may be placed in the port holes to serve as an inner wall or core. These can be readily removed when the weld is finished, thus leaving the original size of port holes.

If the broken piece is to be welded, bevel piece and cylinder to a 45 degree angle. If a brace is cast on the cylinder where the piece is broken then cut out from the piece enough metal to clear the brace so the welder should be able to join the broken piece with the brace. Then in turn to weld it on to the next piece if there be any, and that piece to the flange. The cut made, should be square and a carbon block set underneath as a platform to facilitate the building up of the metal.

To hold the broken piece or pieces in its place, it is necessary to tag it on cold previous to building the furnace, and to keep carbon blocks under the brace, the same sheet steel platform should be placed as in building up new pieces.

After cylinder flange is cherry red *all round* the vertical welds should be made first, the top horizontal welds last; and then get the flange to a cherry red again and follow the same cooling instructions as above.

Methods of Welding Overhead Cracks on Cylinders

In the case of overhead cracks, if the crack should run over six inches from the ends, it would be impossible to weld at the engine; but if less, the same preheating and cooling instructions should be followed.

Place a piece of ⅜ inch sheet steel eight inches wide, and the length of which to be equivalent to the inner diameter of the cylinder on a brick support within the cylinder. On the center of this sheet weld on another piece eight inches wide at right angles, and on top of this another 2½ inch by 8 inch parallel to the bottom sheet.

Enough space should be left between the smaller horizontal sheet and the wall of the cylinder for placing a piece of carbon block 1x2x3 inches on the rear end of the crack; then the welding is begun by building up metal on the carbon, thus filling the bevelled crack until the end of carbon block is reached, and continued by adding blocks and building up the metal, until the front end of the flange is reached, where care should be taken to overcharge the surface of same, so it will finish a continuous joint.

AUTOGENOUS WELDING OF STEEL BOILER PLATES

An interesting report has been issued by the Swiss Society of Steam Boiler Owners, giving particulars of a number of tests carried out by E. Hohn, chief engineer of the society, on various welds made on a steel plate. Fourteen Swiss firms took part in the tests, one of these firms effecting the welds by the use of electric current, while twelve use the oxy-acetylene blow-pipe, and one water-gas. Each firm was given an open-hearth mild-steel plate, of one and the same cast, manufactured by the Thyssen Steel Works. The plate measured 1,100 mm. by 1,100 mm. by 12 mm. (43.30 in. square by 0.472 in.) From the center of this was cut a second plate, measuring 400 mm. by 400 mm. by 12 mm. (15.75 in. square by 0.472 in.), which had to be welded in, the other operations consisting in the welding on of an oval boss, 120 mm. by 80 mm. (4.724 in. by 3.150 in.), of a short tubular piece, 102 mm. (4 in.) in diameter, inserted in a hole cut through the plate thickness, and in welding up artificial cracks made in the plate by means of a saw and a punching-tool. The plates, after treatment at the respective works were returned to the Federal Laboratory for the Testing of Materials, Zurich, where a number of tests were carried out, including tensile tests, cold and hot bending tests, drift and punching tests, impact tests on notched bars, and the attack by acid of the welded parts. The whole of the plates were similarly tested with the greatest care. The plate showing the welds and the location of the test-pieces is illustrated in Fig. 1. The references are as follows:

A—Mild-steel plate, 1,100 mm. by 1,100 mm. by 12 mm.

B—Mild-steel plate, 400 mm. by 400 mm. by 12 mm. welded on both faces.

C—Sawn length; welded on one face.

D—Sawn length; welded on both faces.

E—Cracks made between four holes; a and b welded on one face, and c and d on both faces.

F—Boss, welded directly on plate A.

G—Short tube-length, welded in the direction of the arrow.

The table briefly describing the process of welding as carried out at the different works shows very great variations under the different headings. The work was exactly the same in all instances, but one firm took 45 hours, including the time for cooling, annealing, and straightening, and used 21,000 litres (741 cubic feet) of oxygen, and 18,000 litres (635 cubic feet) of dissolved acetylene; another used about the same amount of both gases, but took 12 hours, presumably for the welding operations considered alone; while of two other firms, one used 5,520 litres (195 cubic feet) of oxygen, 4,800 litres (169 cubic feet) of acetylene, and took 13 hours; the other used 5,125 litres (181 cubic feet) of oxygen, 2,800 litres (98 cubic feet) of acetylene styled "Zinser," and took 5½ hours. The plates as received from the different firms showed a great difference in their outside appearance; some were clean and smooth, while others were rough and dented. The test pieces were all taken from the central portion of the plate, and half the length of each test piece included a portion of the second smaller plate welded in at the center of the larger one. The test pieces for tensile and bending tests were machined on their sides only, and the results of the tests (tensile strength, apparent limit of elasticity, etc.) refer to the portion outside the weld. This was the only means of obtaining a common basis for comparison, for in the tensile

tests fracture occured either at the weld or outside it, and all the test pieces were not of uniform thickness at the welded portion; the increase in thickness in the case of the plate electrically treated was approximately double, while being generally low in the case of those having autogenous welds. Elongation was measured on lengths of 20 cm. (7⅞ in.), and also on 5-cm (2-in.) lengths, outside the fractured portion and outside the weld. By this means the greater elongation at the fracture zone, which was unreliable when it coincided with the weld, did not affect the results, and the figures given for elongation allow of a safe comparison.

The fourteen welded plates and one untreated plate, kept in reserve for comparison purposes, yielded sixty test pieces for tensile tests, fifty-two of which were from plates having autogenous welds. The test pieces measured 3 cm. by 1.2 cm. (1 3/6 in. by 7/16 in.), and 200 mm. (7⅞ in.) in length between gauge points. Of these fifty-two test pieces for tensile tests, twenty-seven, or 52 per cent, broke outside the weld, and twenty-five, or 48 per cent, at the weld itself. Of the four derived from the plate electrically welded, three broke outside the weld, and one at the weld. The direction of rolling was unknown, and could not be taken into consideration. The following are the average results obtained in the case of the fifty-two test pieces proceeding from the autogeneous welded plates, expressed as percentages of the figures for the untreated plate taken as 100:

	Per Cent.
Apparent limit of elasticity	87
Tensile strength	82
Reduction of area	71
Elongation on fracture on 20 cm	58
Elongation 5 cm. outside fracture and weld	53
Coefficient of quality (after Tetmayer)	50

This latter being the product of the tensile strength by the elongation on fracture divided by 100.

The average figures for the twenty-seven test pieces which broke outside the weld, and for the twenty-five which broke at the weld itself, are interesting as a further comparison. They are given in the following table:

	Average of 4 Tests on Untreated Plate.		Average of Tests on 27 Test-Pieces (Outside Weld).		Average of Tests on 25 Test-Pieces (at the Weld).	
Apparent limit of elasticity t/cm	2.66	100	2.35	88	2.25	84
(Tons per sq. in.)	16.89	.....	14.92	.....	14.29	.....
Tensile strength, t/cm	3.87	100	3.36	87	2.96	76
(Tons per sq. in.)	24.57	.....	21.33	.....	18.79	.....
Reductions of area per cent	60.10	100	62.30	104	21.88	36
Elong. in 20 cm., per cent	27.60	100	22.10	80	9.42	34
Elong. in 20 cm., outside fracture, per cent	20.00	100	13.20	66	7.76	39
Co-efficient of quality	1.07	100	0.75	70	0.30	28

As will be seen from the above, the test pieces which broke at the weld had an average tensile strength of 76 per cent only, and an elongation outside the fracture of 39 per cent, while the averages of those which broke outside the weld are respectively 87 and 66 per cent. Both classes of test pieces show a marked decrease in strength.

In considering the tensile strength, the fact should not be lost sight of that the welded plates were annealed, a process which generally tends to decrease the tensile strength, while increasing the elongation. As will be seen the average of the fifty-two tests show the tensile strength to have fallen 82 per cent, and annealing has contributed to this result; an increase in elongation should, on the other hand, have occurred, but this was not the case; it fell to 53 per cent, which indicated that the quality of the metal was injured by the welding operations. This is also evidenced by the coefficient of quality, which fell to 70 and 28 per cent, respectively. The best welded plate had an average coefficient of quality of 0.83, or 78 per cent of the coefficient of quality, 1.07 of the untreated plate; the worst welded plate had a coefficient of quality of only 0.03. This illustrates the very considerable difference which may exist between an autogenous weld made by one firm and that made by another firm.

The electrically welded plate showed slightly better results in the tensile tests, but the ratio of fractures outside the weld and at the weld was 3 to 1, as against 27 to 25, a circumstance which prevents comparison on the same basis. The considerable thickness of the weld also played an important part in the case of this electrically welded plate.

Brinell tests gave for the original plate an average hardness number of 115.6; the average for the fifty-two autogenous welded plates was 102.8, or 89 per cent of the hardness of the original plate, measured outside the weld, and 108.2, or 94 per cent, of the hardness of the original plate, measured at the weld. The decrease of 11 per cent in hardness represents approximately the influence of annealing. The electrically welded plate was less hard than all the others, especially at the weld.

Impact bending tests on notched bars were made on six

Fig. 1.

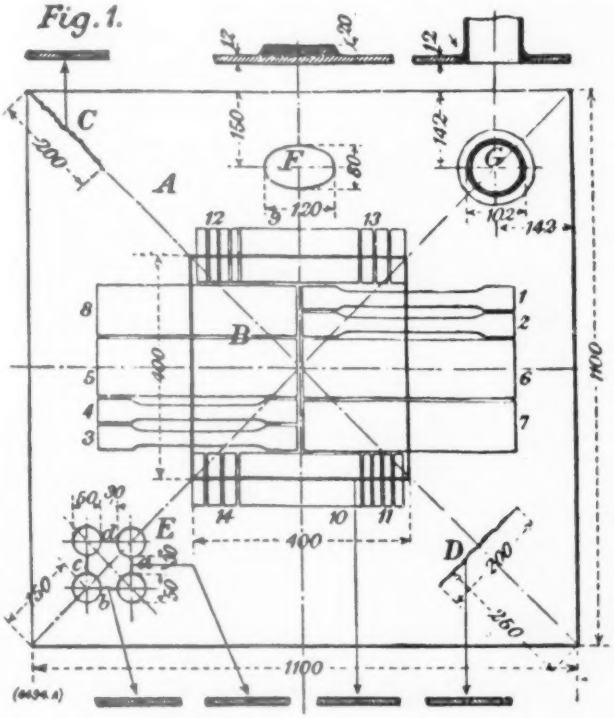


Fig. 2.

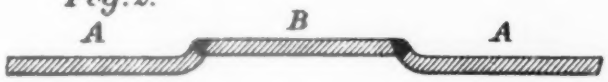


Fig. 3.

Views showing weld and test locations.

specimens taken from each plate. The blow was always applied on the weld in a direction parallel to the joint. There were seventy-eight test specimens taken from the autogenous welded plates, and six from each of the other plates. The report from which we quote—says *Engineering*—enters into the details of these tests for each plate, from which it is gathered that the resilience of the metal had undergone a marked decrease owing to the welding operations—a decrease, in fact, that is larger than the decrease in tensile strength. The plate, which, in the matter of execution of the welds, was one of the best, and which was in the front rank for elongation and malleability, was the last for resilience. Further, the plates which in the tensile tests had given bad results gave satisfactory results in the impact-bending tests.

It would appear that in regard to resistance to bending under impact, the welds which lack homogeneity and are fibrous are superior to those which have greater uniformity and are more homogenous.

These same tests on the specimens taken from the electrically welded plate all gave bad results, notwithstanding the fact that at the weld the thickness was approximately double the original plate thickness.

Impact-bending tests are important, and should always be adopted; moreover, an examination of the fracture shows the character of the weld itself, while in tensile tests a weld is reckoned good when the specimen breaks outside it. These impact bending tests on notched bars afford a simple means of ascertaining what has been the influence of the heat treatment.

Various other tests were carried out on the same plates, including the attack on welded joints by an acid. The illustrations given in the report show clearly the soundness of certain welds and the imperfections in others. The report also contains micro-sections taken from the various plates.

Taken generally, those plates on which the consumption of oxygen, and, consequently, the consumption of gas were the highest gave the better test results. The quality of the gas was not entered into, but it is well known that the gas must be pure, dry and fresh to give a good weld. It should especially contain no sulphur nor phosphorus, and for this reason it is not advisable to use lighting gas in the place of acetylene for important welds, lighting gas being insufficiently pure. The welding metal, wire or rods, should be pure Swedish charcoal iron. The joints to be welded should be opened out with care to a suitable angle and width, and the pieces to be welded should be firmly held together during the welding operations. Several of the plates had been deformed by the welding process, showing that the men who carried out the welds had not had sufficient practice in the lining up and holding together of the parts to be welded. The liquid iron of the points exercises on cooling a retractile action, and if the pieces to be welded are not held firmly their edges shift even while the welding process is proceeding. In cooling, stresses are set up which lead to buckling. During welding, contraction can be counteracted to a certain extent by hammering; also, when the welding is completed, by annealing the piece. Hammering may also take place after annealing. Hammering with small hammers while the piece is still hot improves the metal, but hammering should on no account be carried out at a temperature below red heat. One of the firms demonstrated how hammering could be successfully effected. As shown in Fig. 2, the inside edges of the larger plate were slightly raised, and after welding in the smaller plate B, the work, while the metal was still hot, was hammered down level, as illustrated in Fig. 3. The piece, after welding, should be annealed at a temperature between 700 degrees and 900 degrees C.; annealing is more satisfactorily done in a suitable furnace, but when this is not available it can be carried out with a blow-pipe.

The question of electric welding has been largely discussed of late years, and there are some who much prefer electric to autogenous welds. The tests referred to, made by the Swiss society, do not afford any proof of the superiority of the former over the latter. The average results of the electrically welded plate are, indeed, not equal to the average results given by the thirteen plates having autogenous welds. On the other hand, the firm which carried out the electrical welds for the Swiss society does not deal with welding for steam boilers, but only occasionally effect welding operations on steel castings. Moreover, the firm in question was very busy when it undertook for the Swiss society the trial welding on the plate in question, and this may have had an influence on the results. In these circumstances it is not possible to establish an accurate comparison between the two processes. But the Swiss society wishes to call speci[al] attention to the difference in the heat produced by the b[low]-pipe and that produced by the electric arc. In regard to [en]ergy, if the current be sufficient, the arc is far superior to t[he] blow-pipe. But there are two points to be taken into acco[unt], one being the advantage of using the electric arc, since it m[elts] the metal more easily and more rapidly, and allows the [mak]ing of a real weld, and not simply sticking together of t[he] components; the other point is the danger of overhea[ting] the metal, which is more to be feared with the electric [arc] than with the much more regular heat of the blow-pipe. [A] joint which is welded under a steady and gradual heat [is] much more likely to be a strong joint than one made by [local] and rapid heating.—*Steel and Iron.*

THE ELECTRIC ARC WELDING PROCESS IN SHIP-BUILDING AND REPAIRING

By Robert E. Kinkead*

The most important work done by the arc welding process on board ships is in the repair of the ship's boiler. Owing to the strain which is brought there upon the shell and fire box of the boiler, due to the heaving, rolling and pitching of the ship, there is a greater tendency for the riveted joints and stay bolts to lead than in the case of a stationary boiler. Also, as a general proposition marine boilers work harder for their nominal rating than stationary boilers. This means greater corrosion and more rapid deterioration. In general, the two classes of defects which occur are cracks in the fire box and leaks in the riveted seams and stay bolts. The United States government has very strict rules regarding the application of the process to the welding of marine boilers, but the defects just named can be repaired by the arc welding process. In the case of a riveted seam which leaks due to the fact that the caulked edge has worked away from the plate a reinforcing strip is usually put on the seam, extending from the extreme, edge of the caulked edge to a point beyond the heads of the rivets. This will effectively stop all leaks either around the rivets or at the caulking edge. Where the edge beyond the line of rivets has been eaten away by the corroding action of leaking steam a whole new edge is built up, all work being done, of course, by the metal electrode process. Leaky stay bolts are repaired by reinforcing and welding clear over the top of the stay bolts. Cracks in the fire box are first located and holes drilled in the shell at each end of the crack to be sure that the end of the crack has been reached. Then the intermediate space is chipped out giving two beveled edges. The electric arc process is used almost exclusively for this work, for the reason that it is almost impossible to do the work with oxy-acetylene.

A great deal of welding is done on the decks and deck houses of boats. Most of this work at the present time is in the nature of repair work rather than new construction. On board the boats of the Great Lakes a great deal of welding is done about the hatches which become damaged from loading and unloading. Miscellaneous small jobs are done about a boat when it is laid up for repairs, which mean a great saving of time and money. While at the present time there is very little welding done on the outer shell of the hull, there is considerable work being done about the engine, too, and on the arches and tank tops. One of the latter applications is in burning off rivets where certain plates are to be taken off and new plates put on. Where a rivet is to be driven it is necessary to get one head of the rivet off before it can be taken out. Burning off the head of the rivet and then driving it through is the quickest way devised up to the present time for doing this job. Another application of arc welding when the boat is in drydock is the repairing of what is known as the rudder shoe. This is the heavy steel casting which goes from the stern end of the keel of the ship to the support of the rudder post. It is a rather frequent accurrence for this shoe to become broken and it is necessary to drydock the ship in or-

*Engineering Dept., The Lincoln Electric Co., Cleveland, Ohio.

der to repair it. This job has been done successfully a number of times with the carbon arc process. The rudder frame is usually a steel casting with boiler plate riveted on it. In collisions and wrecks the rudder frequently suffers and repairs are made using the arc welding process.

While a great many applications in the arc welding process have been made up to the present time in shipbuilding and repair practice, there is no doubt but that only a few of the possible applications have been made. The enumeration above probably includes most of the applications which have been made up to the present time.

New York Harbor, the Baltimore Harbor, San Francisco Harbors, are probably the best equipped in arc welding apparatus of any of the seaports in the United States. On the Great Lakes there is a great deal of welding being done.

Up to the present time the equipment used for arc welding purposes in marine practice has been of three types. The engine driven unit, direct connected to a reciprocating engine; the belt driven engine type unit, and the turbine driven engine type unit. The equipment is usually mounted on a boat which is self-propelled by its own steam engine. The boat is equipped with an air compressor usually large enough to take care of two pneumatic hammers, although some of the later boats have been equipped for only one pneumatic hammer. The boat must carry a licensed engineer in addition to one or more boiler makers and one or more operators for the arc welding plant. The charge for the services of the repair boat varies somewhat in different localities. Along the Atlantic coast from $6.00 to $10.00 per hour may be charged. In Baltimore, however, the standard price is $7.00 per hour. On the Great Lakes a great deal of contract work is done, that is, a price is given on each proposed job, and there really is no standard price. The American Shipbuilding has started out with the price of $5.00 per hour, which will undoubtedly be the standard price in the future on the Great Lakes. This price includes a boiler maker, one operator and a helper.

The arc process is used rather than the oxy-acetylene process for marine work because the most important part of the work—boiler repairs—can be done, only by the arc process. The cost of producing the heat for welding is certainly as high with most electric outfits now in operation as it would be if the gas could be used. This high cost of producing the electric power is due to the high investment in the repair boat, the emergency character of the service rendered, which means that the boat lies idle a good percentage of the time, and the practice of using steam driven equipment on a self propelling boat. But owing to the fact that boiler repairs cannot be successfully done by the gas process and the enormous saving resulting from the application of welding in repair work, the electric welding outfit has become a recognized and indispensable part of the ship repair company's equipment. The actual cost per hour per operator on a steam driven outfit which includes air tool equipment varies of course with the continuity of the work. On the Great Lakes the actual cost per operator per hour considering investment and the variation in the amount of work done is probably not less than $2.50. The cost of operating the air compressor is an addition to this figure. The cost of operation in harbors on the sea coast probably does not exceed one-half of the above figure on the average, due to the greater amount of work. Gasoline or oil driven equipment can be operated at a figure in the neighborhood of $1.00 per operator per hour, owing to the fact that a licensed engineer is not required. This type of equipment is to be recommended for small welding repair companies in all cases. The Steam equipment is economical however, for large ship repair companies on the sea coast.

WELDER SAVES THE PRINTER

Everybody in Roswell, New Mexico, has had occasion to hear about the magic of the welder. A clipping from the local paper tells the story:

"The Woodhead & Wilmot mechanics, under the direction of P. D. Taylor, late yesterday evening completed the repair of the big printing press upon which The Evening News has been successfully printed for these many years until its wreck last Saturday evening, in which the broken parts looked as if the whole works had collapsed, and the workmanship displayed in assembling the parts very clearly demonstrates the magnitude of the welding plant which they used. A large casting, weighing several hundred pounds, was broken in five parts, while seven cogs to a large star wheel had been ground into bits. To repair this series of breaks looked like an impossible task to a printer who knows that the repairing of a printing press is different from any other piece of machinery, as the adjustments must be made so as not to vary an infinitesimal fraction of an inch, the thickness of a sheet of paper being used many times to determine the correct adjustment of their mechanism. But these mechanics have surmounted the seemingly impossible in having welded with their electric machine the five different breaks in the ponderous casting, and the usual real newspaper of Roswell this afternoon is the result."

Mr. Taylor makes the following explanation: "The gear had eight teeth and the sliding gear was also broken in several pieces. The frame of the press was also in several pieces. The job was finished without the aid of lathe or machine work of any kind, the press being out of commission for one issue only."

TELLING TIME BY THE SALESMAN

The ability of a salesman to get results is measured to a great extent by the amount of accurate information he gives. For this reason he has been compared to a timepiece.

We are all familiar with the alarm clock that, having been intrusted to the tender mercies of the "only child," has lost its hands. It ticks away at a high speed when wound up, but does not tell us anything. Likewise we are familiar with this kind of salesmen.

A clock with only an hour hand gives a very vague idea of what we want to know. So it is with the salesman who has studied his proposition no further than the price list.

The salesman with the hour and minute hands is well posted in his line, but when it comes to little details is forced to "look it up." He is a good worker but produces average results only.

Representing the finely polished, jeweled-movement watch, timed to the second, tested and found true, its accuracy attested by the approval of the railroads, comes the salesman with the gold fob indicating that he has more than done his duty. How did he land in the 100 per cent class? By always having accurate information.

"What of the stop watch, which splits seconds?" you ask. That type of salesman has ceased selling to become president of the company.

THE LINDE POLICY

A series of advertisements of The Linde Air Products Company, manufacturers of oxygen, will appear in our columns during the next few months. The first of the series find utterance in this issue.

These advertisements strike a new and rather extraordinary note in these days of advancing prices for The Linde Company points out that, from the beginning of the war to the present time, there has been a gradual reduction in the price of their commodity in the face of increasing costs.

Under any circumstances these reductions would be of interest. In the face of the rising market, any reduction whatever becomes a matter of note in that it is so exceptional.

Perhaps the business policy, which has come down through the ages, of securing profit just whenever the opportunity presents itself has stimulated some of the advances which have been made by manufacturers whose costs

have as yet not been seriously advanced owing to war conditions. In many other cases and perhaps in most cases some advance has been justified and in particular cases a radical advance has been necessary.

The Linde Company, however, seems to have taken the position that, in the long run, and covering a series of years, they will build up a friendship, good will and ultimate profit from a consistent policy of reducing the price of their oxygen whenever increased production enables them to do so, even during these days of stress; and that it is better to do this than to take the opportunity which is certainly open to them, to take advantage of present conditions and move the price up.

The Linde Company of course has competition and vigorous competition at that, but an advance in price by The Linde Company would undoubtedly be followed by a similar proportionate advance by others, so that it is undoubtedly true that the oxygen market has been held steady by the broad policy which The Linde Company has followed.

It will be interesting to note as time goes on whether this business policy, which seems to approach the altruistic, will be profitable in the long run; and whether the praise and good will which the company is now receiving from its customers will hold business for them in the face of keen competition when the present trying times are passed —we believe it will. At any rate the future will show whether this broad policy is practical in the long run.

WELDING MONEL METAL

Among the new metals which have made their appearance on the market and which seemed at first to offer unsurmountable difficulties to the welder is monel metal.

Its very composition is enough to make the average welder look upon it with suspicion. The metal contains:

Nickel	70 per cent
Copper	28 per cent
Iron	01.5 per cent
Miscellaneous	00.5 per cent

The foundation being nickel is a difficult proposition to weld and its combination with copper, puts fear into the heart of the average welder. With characteristic energy, however, welders have solved the riddle and are prepared to handle this newest and strangest of metals.

Being non-corrodible from moisture, fumes or acids, the metal is in great demand for certain things, such as for roofs where sulphur fumes destroy iron roofs, for laundry and dairy equipment, for hospital furnishings, for steam turbine blades, acetylene tanks, etc.

It has a greater tensile strength than mild steel. In this respect it is far ahead even of the naval bronzes and manganese bronze.

Ultimate tensile strength—copper—phosphor bronze—manganese bronze per square inch minimum:

Rolled Rods

	Ultimate Tinsile Strength Per Square Inch.
Copper	30,000
Phosphor bronze	50,000
Manganese bronze	72,000
Naval bronze	62,000
Monel metal	84,000

Castings

Phosphor bronze	40,000
Manganese bronze	60,000
Monel metal	65,000

The melting point of monel metal is 1,360 degrees Centigrade or 2,480 degrees Farenheit, while the heat conductivity is only .067 per cent or 1/15 that of copper. These facts are comforting to the welder, as he need not be so careful in heating as he is in welding copper.

The metal when subjected to the welding flame for too long a time becomes crystalline, much after the manner of brass. It must be remembered that the heat conductivity is low and that heating will take a considerable longer time than for copper, brass or steel. For this reason it is always better to preheat except where brazing only is done.

In tests for welding qualities conducted under the supervision of a competent engineer, it was found that preheating the part and using two torches with slightly larger tips than would be used in welding the same sections of steel, a good weld, clean and without blow holes could be made, using one torch to melt a rod of the same material and the other in a circular movement around the path of the weld. In all cases the torch should be advanced in the direction of the progress of the weld, holding the rod at an angle of 45 degrees from the vertical onto the weld.

In the tests for welding a copper flux and also a brass flux was used. These were very satisfactory being made of the soda formulas now in common use. Borax and the single soda flux had the same effect as they have on brass and copper, that of rendering the weld porous and crystalline. A new flux, however, is reported on the market having an even better effect on the nickel content as in cooling an oxide forms from the absorption of gases from the air and to prevent the oxide from mixing with the hot portion of the weld a flux is really necessary.

A larger rod can be used for filling than in welding the same sections in iron or steel as less heat is needed in the weld itself on account of the low heat conductivity and the weld should be made with as even a progress as possible.

In electric resistance, welding such as butt and spot welding the same results are obtained as in steel or iron. The welding of platinum to monel metal for ignition points has been used for several years and has proved an easy proposition. Monel metal sheets can be seam welded by the Thomson process, both in the shape of cylinders for containers and in tubing for piping, etc.

Sheets of monel metal can be welded by the Thomson spot welding process to themselves or to any other weldable metal.

WOMEN TURN MACHINISTS

London, May 5.—Overalled, leather-aproned, capped and goggled—displaying nevertheless a woman's genius for making herself attractive in whatever working guise—some 18 women are being trained in the Notting Hill Gate workshops of the Women's Service Bureau in the skilled engineering work of welding joints and fine flange sockets needed for the construction of aeroplanes.

As fast as they are trained the women are placed in Government factories, where they receive the same pay as men. The woman welder is another instance of woman's adaptability to work believed to be out of her province. She bends over an oxy-acetylene blowpipe with a flame of 6,000 Fahrenheit that can make steel run like sealing wax. Though her eyes are protected by goggles of colored glass, a rain of bright sparks impinge on her face and neck, but she heeds them not, nor obviously does her complexion.

She saws, files and hammers steel, and the women welders' workshop is filled with a hundred loud or shrill clamors of metal, but the nerves of the women welders are unaffected. Miss Woodward, the principal, declares that many of these women, who have never done manual work before, find their work "a nerve tonic," and that headaches are left at home.—From a Canadian Newspaper.

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TORONTO, ONT.
SAN FRANCISCO, CALIF.
MOBERLY, MO.
W. BERKELEY, CALIF.

WHEN THE WAR ENDS

There may be room for an honest difference of opinion as to the necessity for a larger army and a more efficient navy—but there can be no question regarding the necessity for industrial preparedness. Those of us who prefer peace at any price may contend that we have ships and soldiers enough. But there are none who prefer panics and industrial paralysis to prosperity and business activity.

War prevented industrial ruin in this country by bringing commercial ruin upon all Europe. Almost over night it made eager customers of many nations which had been active competitors in our markets.

The war halted a business depression that began with the adoption of the Underwood tariff law. That law, which is still in force, caused such industrial stagnation as to make the year 1914 one of unhappy memory. Under ordinary conditions this country would now be suffering from a panic instead of enjoying unusual prosperity.

Under the present system no change can be expected in our tariff schedules except the substitution of rates even more crude and illogical than those of the Underwood bill.

SO LONG AS THE TARIFF REMAINS A PARTY ISSUE —SO LONG AS SCHEDULES ARE FRAMED IN ACCORDANCE WITH THE DESIRES OF ANY PARTY, OR ANY LOCALITY, OR ANY INDUSTRY—SO LONG WILL SUCH SCHEDULES BE WRONG.

History justifies this assertion. We have never had a really equitable and efficient tariff law. Customs duties in general have been always either too high or too low, and the schedules marked by glaring inconsistencies. Every tariff bill enacted has been followed by a period of depression or an era of over-expansion.

Undoubtedly this has been due as much to lack of intelligence in handling the problem as to the impossibility of any political party viewing the question from the standpoint of the whole people.

Framing a just and efficient tariff law is a task demanding a high degree of SPECIAL SKILL AND KNOWLEDGE, impossible in a committee selected for the emergency from among the members of any Congress.

SUCH A TASK SHOULD BE DELEGATED TO MEN WHOSE ABILITY, INTEGRITY AND OPPORTUNITIES FOR STUDY OF THE QUESTION WILL REMOVE IT FROM THE BANEFUL INFLUENCE OF PARTISANSHIP, SELFISHNESS AND IGNORANCE.

For almost one hundred years the tariff has been a football for politicians and selfish interests. We have repeatedly seen how costly has been this method of handling this great question, and how eagerly Europe has embraced every opportunity to flood this country with her products. Is it not time we adopted a sane method of forming our Tariffs?

What will follow the war if our industrial defenses are not strengthened can only be surmised. There is every reason to expect that economic invasion of this country will be swift and certain. American markets will offer peculiar temptations to impoverished Europe. Money will be sought here to carry the huge burdens left by the greatest struggle in history.

We bring this matter to the attention of the public in order that interest may be aroused in the greatest problem of the hour. We urge upon the American people, now enjoying unexampled prosperity, the necessity of thought for the years to come.

In this way we seek frankly to foster a nation-wide sentiment in favor of the creation of a tariff commission on non-partisan lines. We favor a commission so constituted and protected as to surround the tariff, so far as may be possible, with the same safeguards provided for our judiciary, protecting it alike from partisan zeal, sectional selfishness and commercial greed.

THIS COMMISSION SHOULD BE A PERMANENT BODY, EMPOWERED TO MAKE SUCH ADJUSTMENT OF RATES AS THE EMERGENCY MAY DEMAND PENDING APPROVAL BY CONGRESS, IN ORDER TO AT ALL TIMES PROVIDE REVENUE, PROTECT LABOR AND STABILIZE BUSINESS. Its powers in this direction should be as great as are consistent with the Constitution.

To remove the tariff from the domain of politics will demand the active interest of every good citizen, together with serious consideration of the great problems involved. Opposition will come from selfishness and lack of understanding. If this is met by earnest interest and the enthusiasm inspired by a sense of patriotic duty, it may be overcome.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912.

Statement of the ownership, management, circulation, etc., required by the Act of Congress of August 24, 1912, of The Welding Engineer, published monthly at Chicago, Ill., for April 1st, 1916.

State of Illinois
County of Cook
ss.

Before me, a Notary Public, in and for the State and county aforesaid, personally appeared L. B. Mackenzie, who, having been duly sworn according to law, deposes and says that he is the editor of The Welding Engineer and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 443, Postal Laws and Regulations, printed on the reverse of this form, towit:

1. That the names and addresses of the publisher, editor, managing editor, and business manager are:

Publisher, The Welding Engineer, 608 Dearborn St.

Editor, L. B. Mackenzie, 608 Dearborn St.

Managing Editor, L. B. Mackenzie, 608 Dearborn St.

Business Manager, L. B. Mackenzie, 608 Dearborn St.

2. That the owners are: (Give names and addresses of individual owners, or, if a corporation, give its name and the names and addresses of stockholders owning or holding 1 per cent or more of the total amount of stock.)

L. B. Mackenzie, 220 S. State St.; Margaret J. Hungerford, 6107 Dorchester Ave., Chicago.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: (If there are none, so state.)

None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as a trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

5. That the average number of copies of each issue of this publication sold or distributed, through the mails or

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The Welding Engineer.

Sworn to and subscribed before me this 1st day of April, 1916.

(Seal) J. P. SHARP.

(My commission expires ....., 191 .)

RECENT PATENTS

No. 1,179,753. Tool. Harry Percival Parrock, Buffalo, N. Y. Serial No. 74,067. A cutting tool the patent of which covers a welded connection.

No. 1,180,859. Air-gun barrel. Charles F. Lefever, Plymouth, Mich., assignor to Daisy Mfg. Co., Plymouth. Method of forming gun-barrel including butt welding process.

No. 1,179,185. Packing for machinery. Pierre Hourlier, Paris, France, assignor to L'Air Liquide, Paris, France. Means of preventing leakage in low temperature air machines.

No. 1,178, 807. Gas generator. John B. Huddle, East St. Louis, Ill.

No. 1,178,591. Electrolytic cell. Floyd J. Metzger.

No. 1,181,907. Sheet metal box. Geo. A. Long, Hartford, Conn., assignor to Gray Telephone Pay Station Co., Hartford. Employs welding in manufacture.

No. 1,181,549. Electrolytic cell. Harry T. Shriver, West Orange, N. J.

No. 1,181,116. Method of separating acetylene and hydrogen. Geo. O. Curme, Jr., Pittsburgh, assignor to Prest-O-Lite Co.

No. 1,181,227. Electric welding. O. A. Kenyon, Hastings-upon-Hudson, N. Y. Automatic system of electric welding.

No. 1,179,991. Method of upholstering seat backs. L. A. Young, Detroit, Mich. Spot welding used in connection.

No. 1,180,096. Electric welding apparatus. H. R. Woodrow and Thomas E. Murray, New York City.

POSITIONS WANTED

Position Wanted: All around welder, five years' experience. Married, age 26. Can weld anything. References, Address 11, *The Welding Engineer.*

Position Wanted: Welder experienced in railroad work. Wants position as demonstrator and installing apparatus in railroad shops. Manufacturer selling railroads could use me. Understand boiler work, locomotive work, etc. Am 35, and married. Best references. Address 12, *The Welding Engineer.*

Position Wanted: Experienced welder, having been salesman and branch manager for manufacturer. Wants position with equipment house. Best references. Address 13, *The Welding Engineer.*

Position Wanted: As salesman. Know the welding trade, and will cover any territory. Expenses and commission. Address 14, *The Welding Engineer.*

Partner Wanted: Have had nine years' experience and know oxy-acetylene welding thoroughly. Want a partner to put capital against my time and experience. Best references. Address 15, *The Welding Engineer.*

Position Wanted: As salesman, demonstrator or instructor by experienced welder. Address 16, *The Welding Engineer.*

Are You Looking for a Job?

During the past month The Welding Engineer has received a considerable number of requests to furnish experienced welders and salesmen. We can assume no responsibility in the matter, but are quite willing to act as a clearing house for the trade. Applications for employment or for help which are referred to us will be held in confidence.—Editor.

Jobs for Men

If you are an employer and are in need of a welder or a salesman, write us about it. We may be able to put you in touch with the very man for the job. Tell us what you expect in the way of experience and approximately what you will pay. Also state if electric, thermit or oxy-acetylene experience is required. Your communication will be held in confidence—there will be no publicity.—Editor.

Men for Jobs

The Welding Engineer is always willing to help competent men. If you seek a position, write us and state your experience and wages expected. Give full details about experience—don't be too brief. Be sure to state if your experience covers electric, thermit or oxy-acetylene work. If you are married, say so, and you might add your age. We will treat your letter in confidence and if we can put you in touch with a job it will be our pleasure.—Editor.

Become a Jobber

Inquiries and orders for welding machines and supplies have come to us through this ad. Many of these firms ordering material and supplies have to wait a long time and pay excessive charges for their goods.

We are therefore compelled to turn these inquiries over to jobbers in the states from which these orders come, who can ship the goods wanted quickly and at low rates.

The proposition is a good one and one which will make money for the jobbers who will handle the goods. Write us regarding the selling of welding supplies.

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L. B. MACKENZIE, Editor

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By THEODORE KAUTNY

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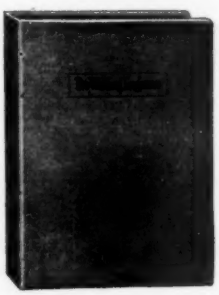

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Oxy-Acetylene Welding and Cutting
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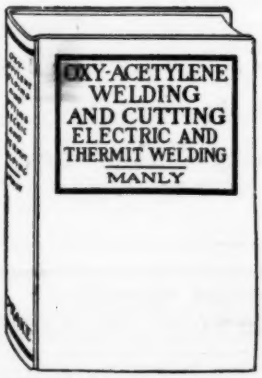
By HAROLD P. MANLY

Chief Engineer American Bureau of Engineering



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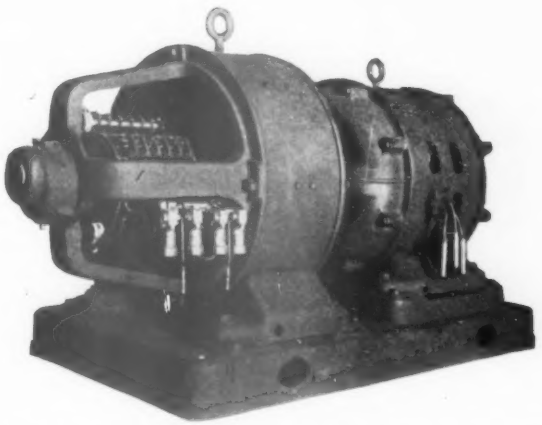

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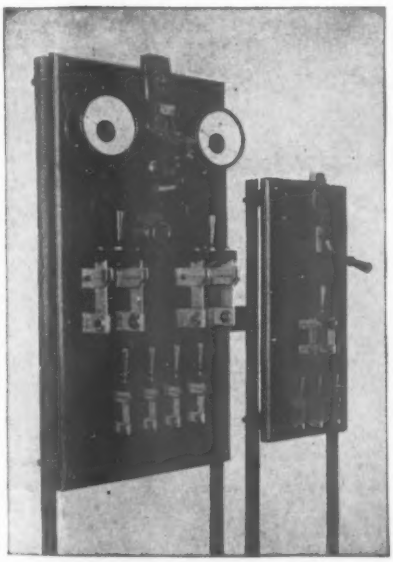

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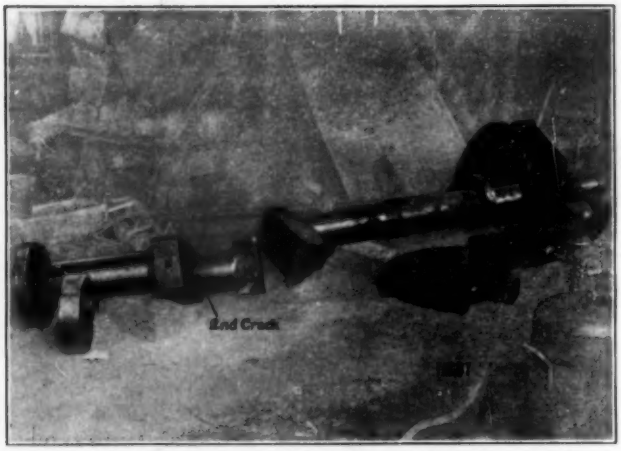

Fig. 3—8½-inch crank shaft broken off next to slab, and there is also another crack opposite the other slab.

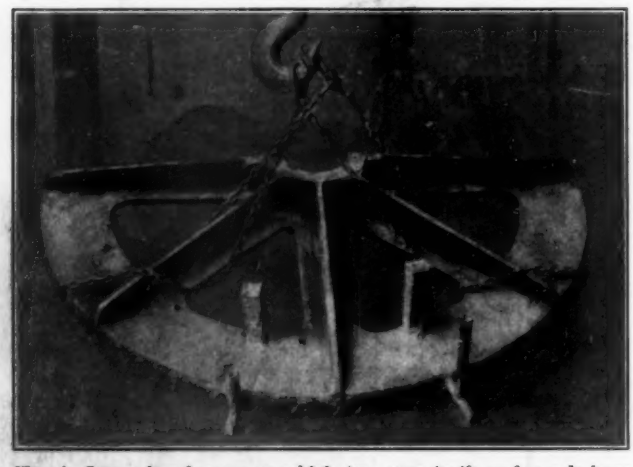

Fig. 4—Large bevel gear on which two new teeth and crack have been repaired.

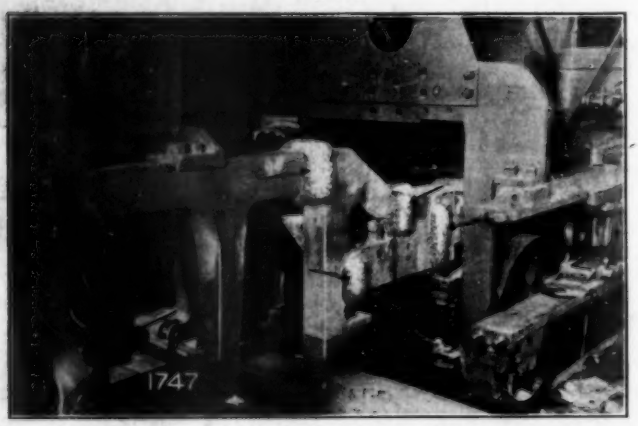

Fig. 7—Four Thermit welds on locomotive frame on the Missouri Pacific Railroad, made without removing the frame from place.

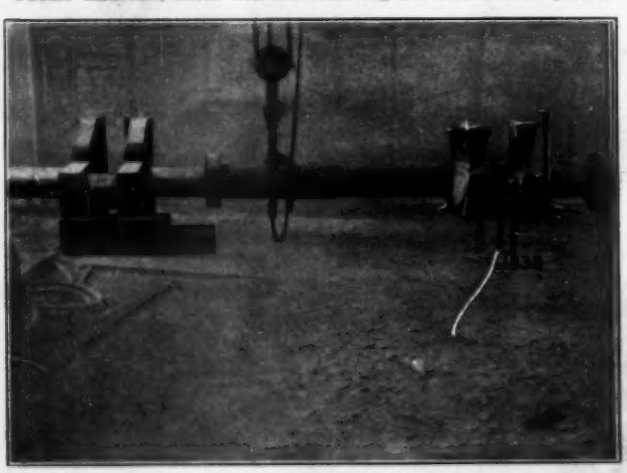

Fig. 8—An entire new pin and slab welded with Thermit before machining.

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